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MOTORSHIP

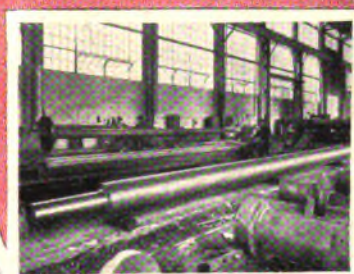
Devoted to Commercial and Naval Motor Craft

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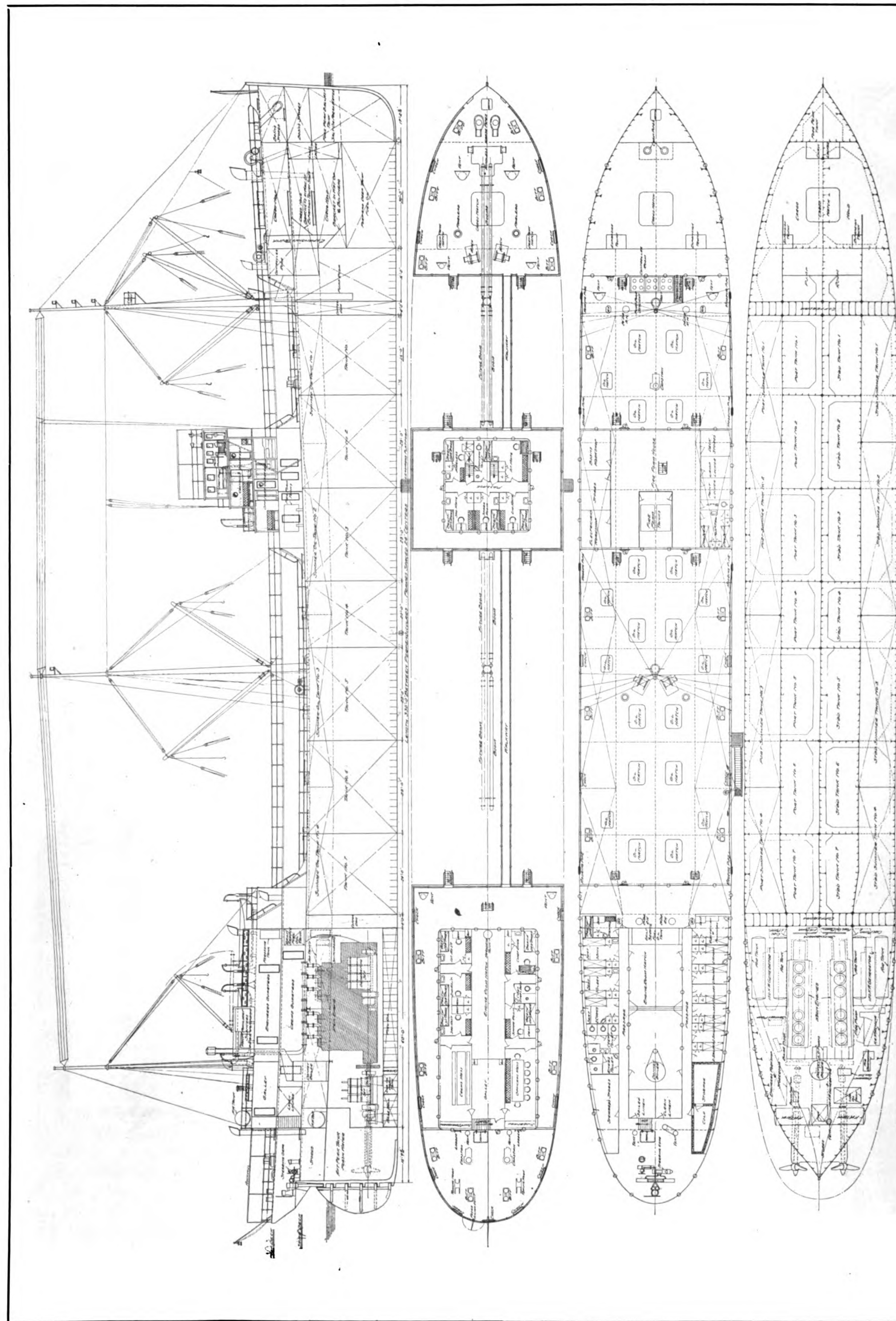
CAMDEN FORGE CO.



Manufacturers of
Large and Small Forgings



CAMDEN, N. J., U. S. A.



MODERN ECONOMICAL MERCHANT SHIPS—NO. 38

The 5,010 tons d.w.c. motor tanker building by the Moore Shipbuilding Co., of Oakland, for the Standard Oil Co., of Cal. She will be propelled by two 1,150 i.h.p. American-built Worksport Diesel engines. Note the small engine-room space. Her capacity of bulk-oil cargo is 585,000 cubic feet and 4,400 barrels of fuel-oil. She is fully described in this issue.

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MOTORSHIP

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149 CALIFORNIA STREET
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The oil-engined motorship has arrived! It is such a pronounced economy that it was bound to come. Nothing could stop it! And all obstacles have been removed as fast as they arose. The law of progress has seen to that. Very strong prejudices stood in the way of steam. But, one after another they were swept aside and steam reigned triumphant for a century. Steam now has had its day! Its zenith has passed, and gradually but surely it is being superseded by the economical internal-combustion power. Steamships are becoming decadent. America, the most important oil-producing country, is to be the greatest motorship-owning nation. Let us all co-operate and assist to make that day soon.

April, 1920 Vol. 5 No. 4

EDITORIAL

REMEMBER THE WISDOM OF SOLOMON!

OF late the controversy between exponents of the two-stroke and four-stroke cycle designs of the Diesel engine has become most vigorous and is again reaching the bitter stage, but without any satisfactory conclusions as to the advantages of one type over the other having been truly proven, unless we take as an argument the past results of pre-war ships in service. This in itself would be unfair, as builders are only now deriving the benefits from previous practical sea-going experiences, which installations may be regarded as experiments rather than as criterions.

In this issue are two articles dealing at length with the two-cycle versus four-cycle question by prominent builders of these two engine-types respectively, and other opinions have been published by us in foregoing issues. Neither of them are sycophantic in their remarks concerning the particular merits of the engine-cycle the other firm builds, apparently preferring to technically condemn instead of live and let live. The latter would be the better solution of the problem, as an industry that is continually divided against itself must ultimately fall. The steam-engine is the greatest competitor of the Diesel-engine because it is the oldest and most accustomed system of propulsion for ships, and this sustained rivalry between the two types of Diesel-engines is hampering the adoption of the more economical power by shipowners, because the rivalry is one that has been carried beyond claiming commercial advantages and has reached the "knocking" stage. This apart from the sub-competition of different four-cycle designs, and the different makes of the two-cycle types carried out by salesmen, or as to the pros and cons of port-scavenging versus valve-in-head scavenging and opposed-piston two-cycle motors. Even the opposed-

piston engine is now divided into two types. Then there is the direct-drive and Diesel-electric systems to be weighed against each other.

All this strife leads to a blind alley and is valuable time wasted, while the steam interests are combining and putting forth a tremendous effort to stem the advance of the indisputably economical Diesel power. The time has come for Diesel-engine manufacturers and users to combine and push the Cause with a mighty sustained Push, or otherwise be outweighed by sheer force of numbers, although their weapons are more modern than the antiquated guns of their mutual enemy. Had this been done earlier the U. S. Shipping Board would have been obliged to have installed oil-engines instead of uneconomical steam-engines and boilers in their ships, as they would not have listened to the overwhelming pressure of the steam interests.

In this very issue are two articles dealing at length with the two-cycle versus four-cycle question by prominent builders of these engine-types respectively. The four-cycle exponents frankly claim that the two-cycle engine is not successful, and that they will always be able to build a four-cycle engine with the same overall dimensions as the corresponding two-cycle engine of equal horse-power and revolutions; while the enthusiastic two-cycle backers demonstrate by means of drawings and figures that the opposite is the case. As must be realized, neither of them are strictly accurate in their claims, although they are quite sincere, both having overlooked certain important factors that go to make the whole. Later we may have some comments to make on the respective claims. But meanwhile the steam men take the opportunity of this rivalry to sneak in at the side door.

(Continued on the next page)

But why publish all these controversial articles and claims, may be asked? Why not suppress them? In this we are in much the same position as the daily-press, which is obliged to publish news of a nature calculated to do a certain amount of harm. They have to credit the majority of their readers with being capable of forming an intelligent opinion for themselves, and of being entitled to that privilege.

PROBABILITY OF AN AMERICAN MOTORSHIP BOOM

IT is to the credit of the American Hawaiian Steamship Company that they will go down in history as being the first disinterested American shipowners, apart from a well-known oil company, to order large ocean-going merchant motorships. In saying "disinterested" we mean to imply that they have no connection with any concern building Diesel oil-engines, so that their order has been placed solely because they are convinced of the economy and of the engineering success of the motorship, whereas the several other large motorships building in the United States are for shipping companies financially connected with engine-building concerns, such as the big ore-carrier for the Ore Steamship Co. of New York.

There can be but little doubt that had a definite shipping program been fixed by the Shipping Board or Government, the American Hawaiian Steamship Company would have ordered more than two eleven-thousand ton Diesel vessels and their recent action would have been done earlier were it not for the recent Federal control of their fleet.

For some time past the Southern Pacific Steamship Co., Pacific Mail Steamship Co., Kerr Steamship Co., W. R. Grace & Co., Munson Line, and the Gulf Refining Co., also others, have been seriously contemplating ordering motorships, but for sundry reasons—best known to themselves—have hesitated in taking definite action. The delay of a definite Government shipping policy has probably held them back. Doubtless the lead taken by the enterprising American Hawaiian Steamship Line will speed up their action, and that very shortly we shall hear of many motorship contracts being signed. The initiative of the latter company may mean a boom in the construction of economical Diesel-engined cargo ships.

During the last few months every domestic marine publication but *Motorship*, and several foreign journals, have stated that a large motorship is being built for W. R. Grace & Co. of New York, at the Wm. Cramp & Son shipyard. Unfortunately, there is no truth whatever in this rumor. However, we hope that the Grace Line will soon order some large steel motorships. They have had a certain amount of experience with some low-powered wooden motorships.

COME TO THE SHOW!

ON the evening of April 12th, the formal opening of America's first mercantile-marine exposition takes place at the Grand Central Palace, and the exhibition will continue until the night of Saturday, April 17th. Never was there a more suitable time than the present to demonstrate to the people of the United States the tremendous value of merchant-vessels. Ocean carriers are just as important to the farmer or automobile manufacturer inland as they are to the manufacturer on the coast. For a country to be prosperous much of its products, whether wheat, or machinery, must be exported, and the greatest prosperity can be obtained by carrying American goods in American ships.

At the same time we cannot run ships at a profit unless they are of the most economical type obtainable, because of the higher cost of American labor. As this Show means

much to you, come along and bring all your friends. We have a booth there, and you are welcome!

THE INDUSTRY NOW HAS AN OPPORTUNITY TO RECIPROCATE

DURING the period that the earth was in the throes of a great war, the importance of which outweighed all other matters, "*Motorship*" succeeded in keeping the Diesel-engine and motorship constantly to the fore. Without the untiring campaign we have sustained for the past four years, there would to-day be very little interest taken in marine oil-engines in this country, whereas the industry has now firmly established itself on a foundation of solid rock. Consequently it will soon be the most important business in the marine field, once more illustrating the highly valuable function that "*Motorship*" is performing. May we now have the heartiest co-operation and support from the shipbuilding and engine manufacturing trades?

SCANDAL OF THE OIL SHORTAGE

AS forecasted by "*Motorship*" long ago, the enormous waste of fuel-oil under the boilers of ships, combined with hold-up of the Mexican supply and other influences, have caused the consumption to exceed the present supply with the result that there now exists a serious shortage at Atlantic ports. To a great measure the Shipping Board is to blame for having completed so many uneconomical oil-fired steamers instead of adopting the efficient Diesel-engined motorship at the outset of the constructional program as planned by Denman and Goethals.

Estimating the quantity of fuel-oil now being used by Federal and privately owned American merchant steamships as being somewhere around 60,000,000 barrels per annum, it means that two-thirds of the quantity, that is to say 40,000,000 barrels, has been absolutely wasted, as had these vessels been Diesel-driven they would only have needed 20,000,000 barrels to have produced the same power. However, it was not possible or practical to install oil-engines in all these ships, but they could have been fitted in most of them, and at least 30,000,000 barrels of oil could have been saved last year, with the result that there would have been no fuel-shortage to-day. It is fortunate that the Russian, Roumanian and Mexican oil-fields may soon be reopened, also that the Mesopotamian supply probably will shortly increase, and that the Asiatic Petroleum Co. has stocks at various seaports abroad, otherwise the future situation would be most serious for American shipowners.

CLOSING OF THE MERCHANT MARINE HEARINGS.—A NEW CONSTRUCTIONAL PROGRAM

AFTER most exhaustive investigations into the merchant marine questions the U. S. Senate Committee on Commerce ended its hearings on Saturday, March 15th. With the exception of a break of a week due to an illness the Committee, under the chairmanship of Senator Wesley L. Jones, held its sessions constantly for three months. The question of Diesel-engined motorships frequently came up, and the evidence was overwhelming in their favor, even from steamship owners such as Mr. Frank C. Munson, no adverse statements having been made.

Senator Jones is now drafting a bill which we understand will provide for rapid retirement of the Government from ownership and operation of ships, and the selling of vessels to private interests. But, it will also recommend a new building program to balance the present fleet. It is to be hoped the Bill will recommend that all new vessels up to 16,000 tons d.w.c. and 15 to 16 knots speed shall be Diesel-driven, and that they shall be turned over to private shipowners as soon as their trials have been run. (See page 331.)

Standard Oil Company's New Motor Tankers

Two Diesel-Driven Ships Now Building on Pacific Coast—One of These Shows Gain of \$157,350.00 Over Annual Earning-Power of Sister Oil-Fired Steamer "El Segundo"

SHIPOWNERS and oil-companies should be more than ordinarily interested in the comparison figures we now are enabled to give between an existing oil-fired steam tanker and a sister Diesel-driven tanker, as the figures show differences that not only are astonishing, but serve to support facts and data previously published in these columns. In view of the enormous gains in favor of the Diesel drive, it seems extraordinary that the directors of leading American oil companies and shipowners have tolerated their marine-engineering departments recommending oil-fired steam machinery in the million tons of ships now under construction in American yards, of which about 65 per cent are tankers, and all of which will add to the serious fuel-shortage now existing.

Recently we announced that order for two twin-screw Diesel-driven tankers have been placed with Pacific Coast shipyards by the Standard Oil Company of California. In order to make it clear that this firm do not consider these vessels to be an experiment they point out that the second and larger motorship was ordered almost before the first was laid down. We already have briefly described the smaller tanker of the two, and we now are enabled to publish plans and full particulars of both vessels.

It is of particular interest to state that the larger of the two new motorships is a duplicate of the oil-fired steamer "El Segundo," built by the New York Shipbuilding Corporation at Camden, N. J., in 1912, and also owned by the Standard Oil Co. So a comparison of the cargo capacity, cubic capacity, fuel-consumption, cruising-radius, horse-power, speed and operating cost forms a most valuable proof of the almost unbelievable superiority of the Diesel-driven vessel.

By a curious coincidence the New York Shipbuilding Co. of Camden, N. J., also own rights to build the same make of Diesel engine as is being installed in the Standard Oil Co.'s motorships, so perhaps the figures here given will expedite their actions. We are greatly indebted to the Standard Oil Company, the New York Shipbuilding Corporation, and to the Moore Shipbuilding Corporation, for the figures which enable us to make the comparison which herewith follows:

A study of the various figures at once reveals the many great advantages of the extraordinary economy of the Diesel oil-engine compared with the oil-fired reciprocating steam-engines, which is 0.40 lb. and 1.30 lb. per shaft h.p. hour, respectively. To this we particularly desire to draw the attention of the Vice-President of the U. S. Emergency Fleet Corporation. Incidentally, we will mention that the consumption of the steamer "El Segundo" is even better than that estimated by the builders, who gave her a designed consumption of 24 tons per day, or one ton more than her actual consumption. In our figures we quote 23 tons per day, or 1.30 lb. per shaft h.p. per hour. The indicated h.p. is 0.30 lb. and 1.13 lb., respectively.

The result of the economy of the Diesel engine is that the motorship can carry 590 cubic tons, or 485 d.w. tons (when loaded with 70 days' supply of fuel), more than the steamer can when loaded with 43 days' supply of fuel. Furthermore, she carries this additional amount of cargo when burning 16 tons less oil-fuel per day than the steamer, or a fuel-saving of \$280.20 per day, with fuel at \$2.50 per barrel.

This means an annual saving of \$70,050 with the ship (a tanker) 250 days at sea. As she carries 485 d.w. tons more than the steamer, it means that her additional cargo revenue should be not less than \$87,300 for nine round voyages (loaded one way) at \$20 per ton.

From these two sources alone the motorship shows an annual gain over the steamer "El Segundo" of \$157,350. The higher the cost of fuel oil, the greater is the saving.

However, the owners and builders anticipate a speed of 11 knots loaded from the motorship, whereas the "El Segundo" has a speed of 10 knots. But, we are not quite clear as to how the additional knot will be obtained. True it is that the twin propellers of the motorship will be smaller, will be in deeper and more solid water, and will maintain far more even revolutions, and the racing in rough weather will be practically nil. But an average of half-a-knot per hour for a year's running would be the best that could be expected from these particular benefits. If she gains a knot in speed she may be able to make one more

voyage a year than the steamer, and this will increase her earning power, our figures being based upon 10 knots speed.

One splendid advantage of the motorship not to be overlooked is the lower cost per cargo-capacity of the complete motorship, despite the higher cost of the Diesel machinery, were the "El Segundo" to be built to-day on the next berth to the new motorship.

True it is that the motorship will cost more per deadweight-capacity ton, but that is of almost no consequence whatever, as the term "d.w.c. ton" is totally misleading, as will be seen from the figures given, both the "El Segundo" and the Diesel-ship having a d.w.c. of 5,010 tons. As both have the same loaded displacement and overall dimensions, it will be realized that the motorship carries from 10% to 12% more cargo per ton of structural steel and power in the hull. We estimate that the motorship's operating expenses will show a reduction of not less than 65%.

We now follow with a description of these vessels, dealing first with the larger of the two. The hull is being built by the Moore Shipbuilding Co. of Oakland, Cal., and the Diesel-engines are being constructed under Werkspoor license by the Skandia Pacific Oil Engine Company of the same city.

This vessel will have a carrying-capacity of approximately 37,000 barrels each of 42 gals. (or 5,285 tons) of refined-oil, together with thirty days' supply of fuel, fresh-water, and stores, on a mean-draft of 22 ft. 6 in. (Lloyds summer freeboard). The bunker capacity is, however, sufficient for a cruising radius of 70 days.

Following the Standard Oil Company's practice, the propelling and auxiliary machinery is located aft, and the pump-room forward, with the cargo-oil tanks amidship. As the vessel is intended for carrying refined oil, cofferdams are fitted at each end of the cargo-tanks, each four feet in length. A deep-tank and cargo-hold is fitted forward of the pump-room. The after peak-tank is fitted for carrying fresh-water and the forepeak tank is fitted for fresh-water or ballast. Fresh-water is also carried in storage-tanks on the after main-deck and in tanks on top of the after-deck and bridge-houses. Fuel-oil is carried in the engine-room double-bottom and in the fore deep-tank, with the two cofferdams as reserve bunker spaces.

In the bridge-houses amidship are fitted quarters for all deck-officers, while the engineers' quarters are located in deck houses on the poop-deck aft. Here are also located the officers' and crews' messroom. Particular care has been taken to have all quarters comfortable, and the quarters on the after-deck being built up against the side of the engine-casing, have these sides sound-proofed to prevent the noise from the engine-room being transferred into these quarters. The quarters for deck and engine-room crews, and for steward's department, are fitted on the port and starboard sides under the poop-deck aft, with only two men to each room.

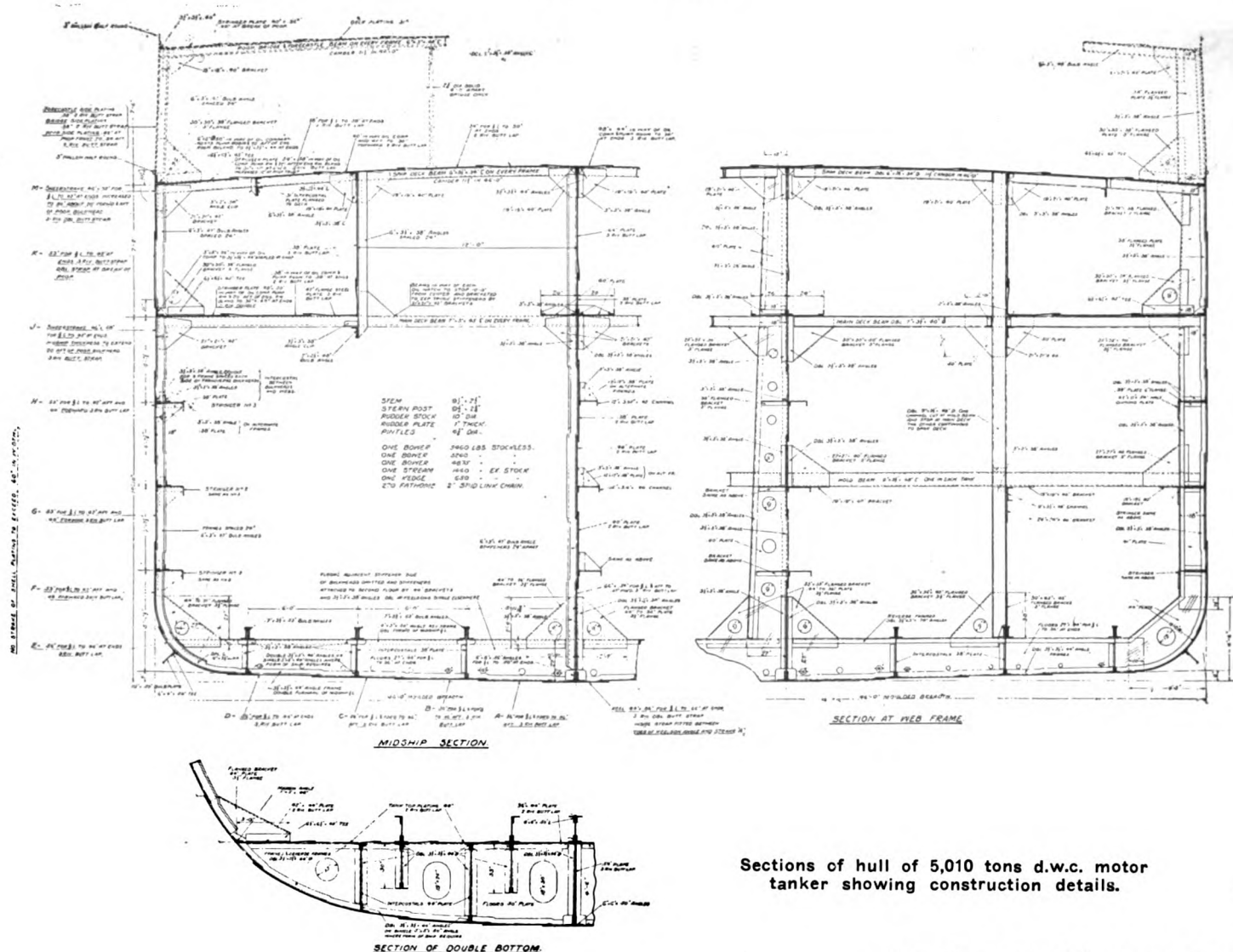
The crew's quarters of this vessel and of the smaller ship are aft and are fitted with forced ventilation from a motor-driven Sturtevant blower located on the after main deck. All rooms are equipped with electric-heaters, ranging in capacity from 750 to 1,500 watts each. All officers' quarters are also fitted with electric-fans. Shower-baths are fitted throughout the vessel.

The entire galley-equipment is electric, and consists of a range, broiler, griddle, electric hot-table, bake-oven, water-heater with thermostat switch, and two coffee urns, as well as the necessary dresser, sinks, racks, etc. The Edison Electric Appliance Company supplied these electric fittings for the two motorships.

For fire protection on both of these motorships there is installed a Foam-Fire extinguishing equipment, as developed and tested-out by the Standard Oil Company. The equipment, which consists of two solution storage-tanks per ship, connected through hoses and mixing nozzles, have proved very efficient in putting out oil fires. The storage-tanks are charged with air-pressure from the maneuvering air-tanks in the engine-room.

COMPARISON BETWEEN STEAM TANKER AND MOTOR TANKER
(Sister Vessels)

	Steamer "El Segundo"	Diesel Motorship
Length (O. A.)	343 ft. 8 in.	342 ft.
Length (B. P.)	330 ft.	330 ft.
Breadth (moulded)	46 ft. 2 in.	46 ft.
Depth (to spar deck)	27 ft. 5 in.	27 ft.
Depth (to main deck)	20 ft.	19 ft. 10 in.
Draught (mean loaded)	22 ft. 6 in.	22 ft. 6 in.
Displacement (loaded)	7615 tons	7615 tons
Gross tonnage	3664 tons	3664 tons
Dead-weight-capacity	5010 tons	5010 tons
Cubic cargo-capacity	5260 tons	5850 tons
Carrying capacity (with 30 days' fuel-supply on 22½ ft. draught)	33,600 barrels	37,000 barrels
Fuel-capacity	or 4800 tons	or 5285 tons
Shaft horse-power	7100 barrels	4400 barrels
Indicated horse-power	1650 b.h.p.	1650 b.h.p.
Cruising radius	1800 h.p. (steam)	2300 h.p. (Diesel)
Loaded speed	43 days	70 days
Daily fuel-consumption at sea (oil)	10 knots (actual)	11 knots (designed)
Fuel-consumption (per I.H.P. hour)	23 tons (160 barrels)	7 tons (49 barrels)
Fuel-consumption (per shaft H.P. hour)	1.13 lb.	0.30 lb.
Type of ship	1.30 lb.	0.40 lb.
Number of cylinders	Single-screw	Twin-screw
Bore	3	12
Stroke	21 in. x 35 in. x 58 in.	20.43 in.
Propeller speed	42 in.	35.43 in.
Type of engines	91	135 R.P.M.
Make of engines	Oil-fired triple expansion	Oil-burning 4-cycle-Diesel
	New York S. B. Co.	Skandia-Werkspoor



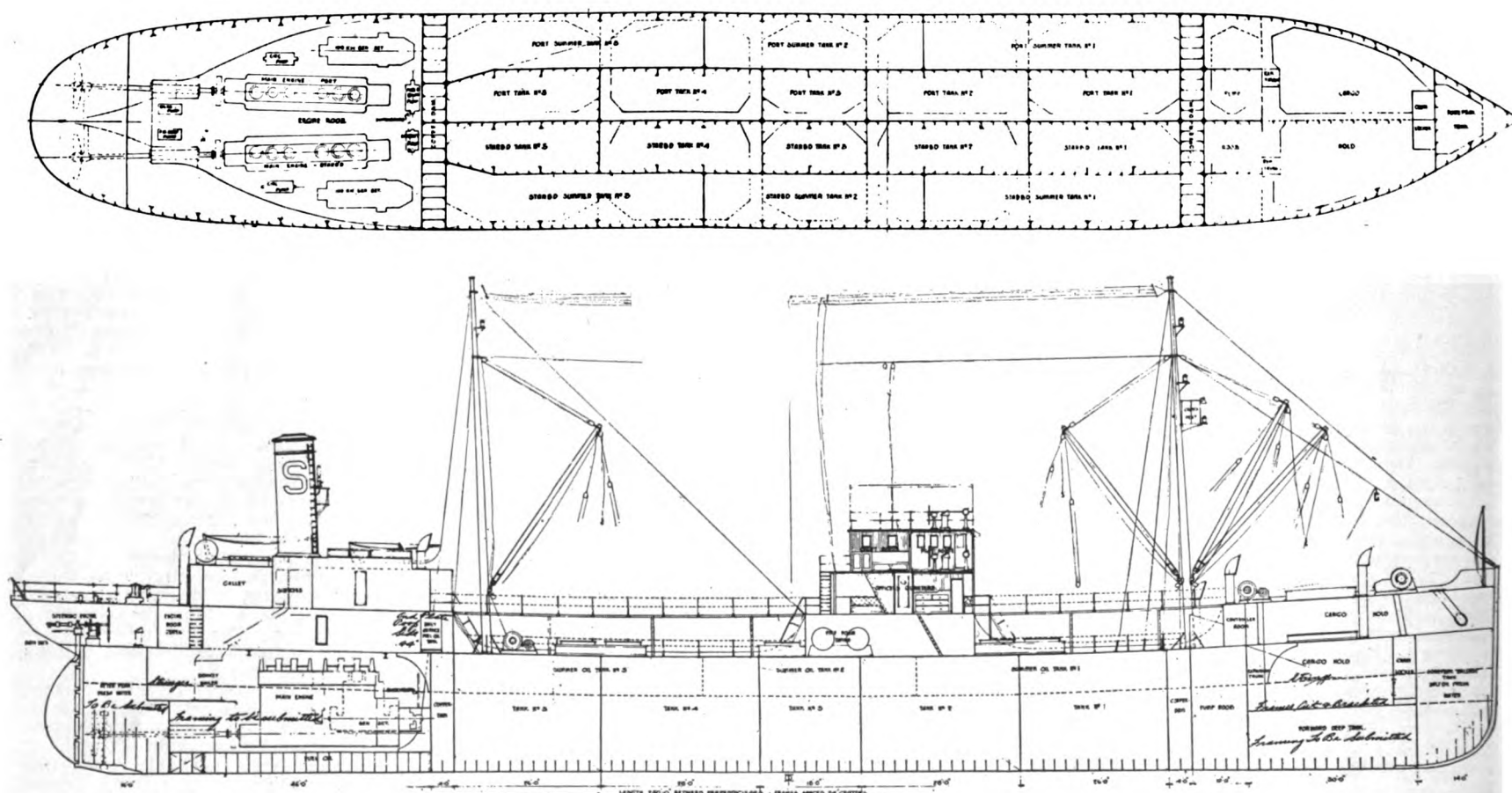
Sections of hull of 5,010 tons d.w.c. motor tanker showing construction details.

A complete system of telephones of the Magnavox design will be installed for communication between the various parts of the ship.

The propelling machinery consists of two Werkspoor marine Diesel engines designed to develop 825 shaft B.H.P. each at 135 R.P.M., giving a total

propelling power of 1,650 B.H.P., which is expected to give the vessel a speed of 11 knots loaded. These engines are built by the Skandia Pacific Oil Engine Company in Oakland under a Werkspoor license, and have water-cooled cylinders and pistons and a forced system of lubrica-

tion. They were fully described in "Motorship" of January, 1920. The maneuvering-air tanks, of which there are four, with a total capacity of 1,300 cubic-feet, are placed in the tween-deck space of the engine-room. The main and auxiliary silencers are located in a silencer-house on top of the after deck-house, and the exhaust-pipes are carried up along the mizzen mast, thus carrying the exhaust-



Motor tanker of 5,010 tons d.w.c. building by the Union Construction Company, of Oakland, for the Standard Oil Co., of Cal. Two 650 i.h.p. American-built Werkspoor Diesel engines are being fitted. The larger vessel is illustrated on page 290 of this issue.

gases well away from the deck, and at the same time facilitating observation of color of the exhaust-gases from the individual engines. The Diesel-electric drive has been adapted for the auxiliaries.

The lubricating-oil system consists of two pumps (one spare), two coolers and two filters. The pumps draw from a drain tank in the double-bottom and discharge through coolers to the main engines, a portion of the oil being constantly diverted to the filters, from which it drains back into the drain-tank.

The two water-circulating pumps, one of which is kept in reserve, are each capable of supplying all cooling-water required by main and auxiliary engines, and the piping is so arranged that either all or any portion of the cooling-water may be sent through the oil-cooler at will, thus having the cooling effect entirely under the control of the operating-engineer.

A fuel-oil service pump is fitted for drawing from the engine room double-bottom and after cofferdam, and discharging to the fuel-oil daily service-tanks, located in the upper engine-room. From these tanks the fuel-oil is fed to the main-engines by gravity flow. These tanks may also be filled from the fuel-oil transfer pump located in the cargo-pump room, which is arranged to draw from the fore deep-tank and forward cofferdam and to discharge to the engine-room double bottom.

One auxiliary and one Booster compressor are also installed in engine-room. The former will compress from atmosphere to 350 pounds per square inch and discharge to the maneuvering air tanks. The Booster compressor is capable of furnishing injection-air at a pressure of 1,000 pounds per square-inch, drawing either from the atmosphere or from the maneuvering-air tanks.

There is also fitted a three-stage turbine fire and bilge pump and a two-stage sanitary pump. The latter has a connection on the suction side to the cooling-water overboard discharge from the main engines. This arrangement utilizes the warm salt-water from the engines for all showers and other purposes throughout the ship.

A fresh-water pump is fitted, arranged to draw from the after-peak tank and discharge to all fresh-water storage tanks on deck and deck houses. A bilge-pump is also fitted, drawing from the engine-room bilges and discharging overboard.

A donkey-boiler of the submerged-head type is fitted in the engine-room for steaming-out the cargo-oil tanks. This boiler will operate on salt-water and is equipped with a mechanical fuel-oil burner, fuel-oil being supplied from the daily service tank. In connection with this boiler there is also fitted a small steam-driven duplex donkey-boiler feed-pump, drawing from the sea and discharging to boiler. As the boiler is also capable of being used as an evaporator there is also installed a distiller in the upper engine-room casing.

The refrigerating plant consists of a No. 6 Audiffren & Singrun ice machine and refrigerating chambers with separate compartments for meat and vegetables. The refrigerating-rooms are insulated with Balsa Wood, as per specification of the Balsa Corporation.

All the auxiliary machinery of this vessel being Diesel-electric driven, in addition to electric heating and galley equipment, a good size electric plant is required. This consists of two 200 B.H.P. and one 150 B.H.P. Dow-Diesel engines direct-connected to two 150 K.W. and one 100 K.W. 250-volt direct-current G.E.C. generators respectively. These Diesel engines are built by the Dow Pump & Diesel Engine Company, Alameda, Cal., and the generators are furnished by the General Electric Company of Schenectady.

In addition to this a small Skandia surface-emission oil-engine generating-set is installed with a capacity of 10 K.W. This set may be started by hand and is capable of furnishing all necessary lighting when no other auxiliary is running, and will also run the Booster compressor, thus enabling injection-bottles on one of the auxiliary sets to be filled if all the air should have been lost.

All motors and other electric equipment on the vessel are supplied with 250-volt direct current. The lighting, however, is all wired on the 125-volt three-wire system. A small balance set being installed to obtain the reduced voltage. The switch-board controlling all main feeders is located in the forward end of the engine-room amidship.

The cargo-oil piping system is so arranged that three different grades of oil may be carried in the main cargo-tanks, and all three grades may be either loaded or discharged simultaneously without mixing. Each of the three suction-lines are connected to three of the seven cargo-tanks giving extreme flexibility in operation. The summer-tanks are arranged to drain into main cargo-tanks, and are also equipped with separate suction.

The cargo pumping-equipment consists of three main cargo-pumps built by the Kinney Mfg. Co.,

each capable of delivering 1,000 bbls. per hour, thus the entire cargo of 37,000 barrels may be discharged in about twelve hours. The piping in the pump-room is so arranged that any pump can draw from any tank and from sea, and discharge to any tank, overboard and to any of the three discharge lines.

In the pump-room is also located a fuel-oil transfer-pump, arranged to draw from the fore-deep tank and from the forward cofferdam, and discharge to the engine-room double-bottom. A bilge and ballast pump is also fitted with suction from the pump-room bilges, fore deep-tank, and fore-peak, discharging overboard.

Due to the possible accumulation of explosive gases in the pump-room, and the occasional sparking at the commutator of a direct-current motor, it was found necessary to make special provision to eliminate this danger. To accomplish this all the motors in the pump room are of the enclosed, gas-proof, ventilated type. Air for ventilation is furnished by a Sturtevant blower located in a controller-room directly over the pump-room. This blower takes air through a ventilator and discharges through an air-duct with branches leading to each motor. With this arrangement gases cannot leak into the motors as the pressure inside the casing is greater than that outside. All control equipment for the pump-room motors are also located in the above named controller-room, making it possible to fully control the pumps from deck. The same ventilating equipment and installation is fitted in the smaller ship that we are about to describe.

The steering-engine is of the hydro-electric type, built by the Hyde Windlass Co., Bath, Maine, and is controlled through a hydraulic telemotor of the outside-packed plunger type fitted with a helm indicator in the pilot-house.

The deck machinery consists of the following: one Windlass, four single-drum Cargo and Warping Winches (two on forward and two on after deck), three Capstans (one on forward deck and one on poop deck aft). All of the above deck machinery is constructed by the Allan Cunningham Company, of Seattle, Wash., and is fitted with General Electric motors throughout. The winch motors are of the weatherproof type mounted on top of a watertight hollow base, which contains the controllers and resistances, thus making each unit entirely self-contained. The controller is worked from a pump lever which may be swung to any desired angle. The winches are fitted with full torque magnetic brake.

The electric capstans have both motors, controllers and resistances mounted in the weather-proof hollow base, making the top entirely flush for the handling of lines. The windlass motor, controller and resistors are of the same general construction as those for the winches. The windlass is of the combined worm and spur gear type, the worm running in a bath of oil. A special construction at the lower end of the hawse pipes, where the shell is recessed makes it possible to pull the anchors inside the line of the shell plating, leaving no projecting parts. This is a decided advantage in docking in tight quarters as well as in the handling of lines in general.

The second and smaller motorship is a combination tanker and freighter and is being built at the yard of the Union Construction Co., also of Oakland, Cal., and is a twin-screw ship, fitted with two 550 b.h.p. six-cylinder Werkspoor Diesel-engines of the four-cycle crosshead and guide type, both turning at 165 R.P.M. A speed of 11.25 knots is estimated, but as mentioned on page 24 of our January issue, we do not expect more than an average sea-speed of 10-10½ knots from this power. She has the following dimensions:

Deadweight-capacity	2,800 tons
Carrying capacity	16,000 barrels (2,285 tons)
Fuel-capacity	2,700 barrels (385½ tons)
Fresh-water-capacity	44½ tons
Cargo-space of Forward hold	15,000 cubic ft.
Power	1,100 shaft h. p.
Power	1,300 Ind. h. p.
Engine-speed	165 R. P. M.
Cruising Radius	30 days
Length (O. A.)	262 ft. 0 in.
Length (B. P.)	250 ft. 0 in.
Breadth (Moulded)	37 ft. 0 in.
Depth (Moulded)	21 ft. 0 in.
Draught (Loaded)	17 ft. 0 in.
Draught (Mean)	18 ft. 3 in.
Daily Fuel-Consumption (at sea)	4½ tons (31 barrels)
Daily Fuel-Consumption (in port) *	1½ tons (12½ barrels)

*With all cargo-pumps, etc., working.

As in the case of the larger tanker, all auxiliary machinery is electric-driven, power for driving the motors being furnished by two

150 b.h.p Dow Diesel-engines, each connected to a 100 K.W. 250 volt General Electric Co.'s generators. Also all galley equipment, heating and lighting throughout is by electricity.

For the force-feed lubricating-system of the main engines, and for the fuel-oil service three Kinney electric-driven pumps are installed, one pump being a spare unit. The lubricating-oil cooler is by the C. F. Braun Co., while the lubricating-oil filter is manufactured by the Richardson-Phenix Co., of Milwaukee, Wis.

In the engine-room is fitted an auxiliary air-compressor arranged to draw from the atmosphere and deliver maneuvering-air to the four large maneuvering-air tanks at a pressure of fifty pounds a square-inch.

A small Booster-compressor is arranged to draw the maneuvering-air tanks and compress to 1,000 pounds a square-inch for filling the injection-air bottles. Both compressors are motor-driven and are furnished by the Rix Compressed Air & Drill Company. A motor-driven centrifugal fresh-water pump, built by the Krogh Pump & Machinery Company, is fitted; this is arranged to draw from the after peak and to discharge to service-tanks on top of deck-houses and to the galley.

There is a small emergency generating-set, consisting of a 16-horsepower Skandia engine direct-connected to a 10-kilowatt 250-volt generator. This unit is capable of being started by hand.

As in the case of the large tanker just described, a donkey-boiler of the submerged-head type for steaming out cargo-oil tanks is fitted in the engine-room. This boiler is also capable of being used as an evaporator, and is equipped with a mechanical fuel oil-burning apparatus. In the pump-room are located four Fairbanks-Morse pumps with superimposed electric-motors.

All cabins are equipped with electric air-heaters of the navy type, furnished by the American Electric Heater Company.

The deck-machinery consists of one windlass with a 25-horsepower motor, four cargo-winches, each with a 15-horsepower motor, and two capstans, each with a 10-horsepower motor. All this machinery is furnished by the Allan Cunningham Company of Seattle, and has General Electric water-proof motors, and the control apparatus is mounted in water-tight base of each unit, arranged with ventilated openings. The steering-engine is of the hydro-electric type, built by the Hyde Windlass Company of Bath, Maine, and is fitted with the Donkin type of hydro-electric telemotor and electric indicator.

NORWEGIAN SINGLE-SCREW MOTORSHIP "SAN MIGUEL" LAUNCHED IN HOLLAND.

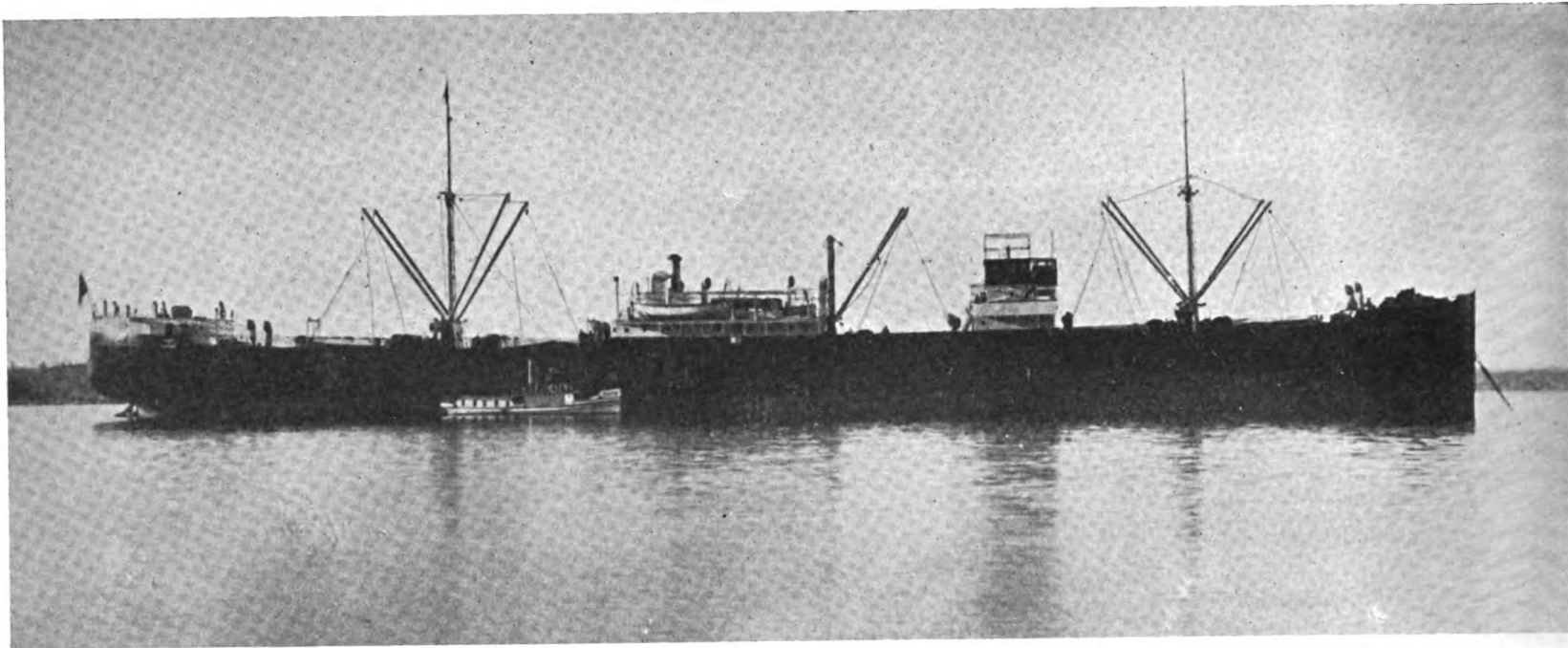
An interesting little steel motorship has been launched for Norwegian owners at the J. & K. Smit Shipyard, Kinderdijk, Holland. This is the "San Miguel," a single-screw Diesel-driven freighter for the Otto and Thor Thoresen Line of Christiania. She is of the spar deck type, built under Norwegian Veritas classification and special survey. Her dimensions are as follows:—

Displacement (loaded)	4,050 tons
Carrying-Capacity	3,000 tons
Fuel-Capacity	500 tons
Length (B.P.)	276 ft. 1 in.
Breadth	29 ft. 8 in.
Depth (to main deck)	26 ft. 4 in.
Depth (to bridge deck)	16 ft. 5 in.
Power	1,400 I.H.P.
Engine-Speed	125 R.P.M.
Make of Engine	Werkspoor
Type of Engine	Four-cycle Diesel

Electrical auxiliaries are installed throughout, there being six electric-winches, one electric-windlass and electric-steering-engine. She is a

Deadweight-capacity	2,800 tons
Carrying capacity	16,000 barrels (2,285 tons)
Fuel-capacity	2,700 barrels (385½ tons)
Fresh-water-capacity	44½ tons
Cargo-space of Forward hold	15,000 cubic ft.
Power	1,100 shaft h. p.
Power	1,300 Ind. h. p.
Engine-speed	165 R. P. M.
Cruising Radius	30 days
Length (O. A.)	262 ft. 0 in.
Length (B. P.)	250 ft. 0 in.
Breadth (Moulded)	37 ft. 0 in.
Depth (Moulded)	21 ft. 0 in.
Draught (Loaded)	17 ft. 0 in.
Draught (Mean)	18 ft. 3 in.
Daily Fuel-Consumption (at sea)	4½ tons (31 barrels)
Daily Fuel-Consumption (in port) *	1½ tons (12½ barrels)

two-masted ship, the masts being telescopic. On the berth from which she was launched the keel of another motorship was laid down for the same owners.



The motorship "Stureholm," 7,800 tons d.wc. She will be at Pier 90, Foot of 50th St. and North River, New York City, until the end of March.

The Motorship "Stureholm"

An Interesting Visitor to New York—Some Valuable Operation Data for Steamship Owners

WHEN we first saw the new Swedish motorship "Stureholm" it was one of those "delightful" autumn days that Sweden occasionally saves for visitors to her shores—the rain was lashing torrents, the wind blowing guns, almost chilling one's marrows, a real bleak day. We went down in a tug at Göteborg to where this ship was moored only to reach her just as the last hawser was cast off as she started off on her maiden voyage, so our anticipated visit was postponed.

It was very similar weather when we recently went aboard her in New York harbor in company with Mr. Kermit Roosevelt (son of the late Colonel Theodore Roosevelt), Mr. A. E. Clegg, and J. J. Sharp, of the Kerr Navigation Corporation, Mr. A. M. Harris, of Harris, Forbes & Co., and representatives of other shipowning and shipbuilding companies, including the Merchants Shipbuilding Corp. and the American Hawaiian Steamship Co.; but we are glad to say that the weather did not dampen the enthusiasm of the visitors to the "Stureholm."

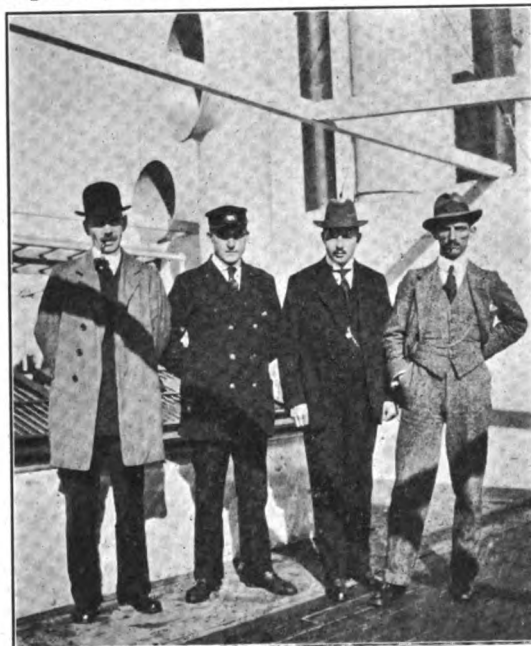
This ocean-going motor-vessel is owned by the Swedish-America-Mexico Line of Göteborg, and was built by the Götaverken of the same city, but the engines were built by Burmeister & Wain. In fact, they had been lying on the dock at Göteborg for three or four years, there having been insufficient steel to complete her hull until after the war was over. She is a twin-screw freighter, with the cruiser-type stern, has five hatches served by ten 12½ h.p. electric-winchs working at 150 ft. per minute, two winches per hold lifting 30 tons. The "Stureholm's" dimensions, etc., are as follows:

Dead-weight capacity.....	7,800 tons
Actual cargo-capacity of holds with fuel for 10,000 miles in bunkers and stores, etc.	7,200 tons
Cubic capacity (bales).....	419,611 ft.
Cubic-capacity (grain).....	457,000 ft.
Fuel actually consumed during 11,380 miles run	484 tons
Bunker capacity.....	1,000 tons
Length (O. A.).....	409 ft.
Breadth (moulded).....	53 ft. 9 in.
Draught	26 ft.
Indicated horse-power.....	2,960 H.P.
Shaft horse-power.....	2,250 H.P.
Engine-speed	140 R.P.M.
Daily fuel-consumption (incl. auxiliaries at sea)	10.22 tons

Fuel-consumption per Ind. H.P. hour....	0.317 lb.
Fuel-consumption per shaft H.P. hour....	0.418 lb.
Auxiliary power required at sea.....	85 b.h.p.
Auxiliary power required in port.....	85 to 170 b.h.p.
Reserve auxiliary power.....	85 b.h.p.
Port fuel-consumption.....	½ to ¾ tons
No. of cylinders per engine.....	6
Bore and stroke.....	23.288 in. by 35.433 in.
Rated power per engine.....	1,300 I.H.P. at 130 R.P.M.
Mean indicated-pressure (from diagram),	91.75 lbs. per sq. in.
Piston speed.....	830 ft. per min.
Mechanical efficiency of engines.....	76 per cent
Total crew	32

There is a small donkey-boiler for heating the ship, and this unit burns more fuel than all the other auxiliaries together.

The complement of the ship consists of captain, chief-officer (who also operates wireless), second-officer, third officer, chief-engineer, three assistant-engineers, six oilers,



On the left, Chief-Engineer Axel Carman. On the right, Mr. M. Michelsen, the Guarantee-Engineer.

three motormen (one motorman also is electrician and gets \$80 per month), carpenter, bo's'n, six deck-hands, two apprentices, steward, cook, waiter, and two mess-room boys, a total of 32 men and boys.

This is the "Stureholm's" second visit to the United States. The first time she came

she bunkered at Baltimore with Standard Oil Co.'s Solar Oil at \$2.94 per barrel, this fuel having the following specifications:

Beaume at 60.....	318 deg.
Flash.....	170 deg. Abel up.
Power	0 deg.
Sulphur	0.81 per cent
B.T.O.	19,320
Lbs. per gallon.....	7.219

At that time (Nov., 1919), the price of this oil in Sweden was 220 kroners (\$11) per barrel, but, of course, is much dearer now. But as she only needs about 400 tons for a round voyage to Sweden and return, it will be seen that considerable profit can be made by bunkering 1,000 tons of oil-fuel in America and discharging about 600 tons as cargo in Scandinavia, or by feeding other ships that are on routes where oil is not easy to obtain except at high cost.

One thousand tons of oil at \$20.58 per ton means a bunker-bill of \$20,580. Selling six hundred tons of this at \$77 per ton means \$46,200. This represents a possible profit of \$25,620 per round voyage in addition to the ship having absolutely no fuel-bill. A gain quite impossible with an oil-fired steamer of the same size and power, which would burn 1,200 tons of fuel on this round voyage. In addition the motorship "Stureholm" can carry about 700 tons more general cargo in her holds than can the steamer, which means an additional revenue of about \$30,000 per round voyage, provided she is fully loaded each way.

These two advantages alone, based on six round voyages per year, mean an annual gain together of \$333,720, without taking into consideration the fact that the motorship on this route need not have any fuel bills.

It may be put forward as an argument against this that such a gain is only possible under present conditions. But we have to remember that Scandinavia has no oil, and that all liquid fuel has to be imported. Furthermore, the higher the price fuel becomes the greater the profit there will be on this practice of selling surplus bunker-oil. Thus the tendency is for motorships to make just a good showing on transatlantic routes as on long voyages.

However, the recent change in the oil situation which has produced a scarcity of fuel-oil of all grades, and which will last for about six months, is adverse to this procedure, as foreign motorships can only secure just enough fuel at American ports to look after their own immediate needs. When at Baltimore on this trip, prior to reaching New York, the "Stureholm" took about 425 tons of Solar-oil, for which she paid \$6.30 per barrel to the Prudential Oil Company. But she had 175 tons of her previous supply left in her double bottoms.

We have secured some useful data concerning the three one-way voyages of this ship. From this and the information given above, shipowners should be able to compile approximate operating and earning costs of this economical ship for the purpose of comparing them with their own "out-of-date" oil-fired or coal-burning steamers. We think the differences, if taken on a yearly computation, will be astonishing and perhaps almost unbelievable and will reveal that our comparison figures are very conservative, as we have omitted many advantages.

VOYAGES OF MOTORSHIP "STUREHOLM"

Göteborg—Baltimore

Oct. 11, 1919, to Oct. 27, 1919

Distance 3,800 miles
Time for trip (including maneuvers) 371 hours
Average speed 10.2 knots
Distance by log 3,737 miles
Time with log 354 hours
Average speed 10.5 knots
Fuel used on trip 144 tons
Lubricating-oil used on trip 717 kgs.
Cargo (incl. fuel) 5,782 tons
Mean draught 19 ft. 1 in.

New York—Göteborg

Nov. 30, 1919, to Dec. 15, 1919

Distance 3,580 miles
Time for trip (incl. maneuvers) 356 hours
Average speed 10.05 knots
Distance by log 3,561 miles
Time with log 352 hours
Average speed 10.1 knots
Fuel used on trip 146½ tons
Oil used on trip 722 kgs.
Cargo (incl. fuel) 7,049 tons
Mean draught 22 ft. 6 in.

Göteborg—Baltimore

Feb. 7, 1920, to Feb. 27, 1920

Distance (to get rid of the ice about Cape Race added 200 miles) 4,000 miles
Time for trip (incl. maneuvers) 576 hours
Average speed 7 knots
Distance by log 3,876 miles
Time with log 462 hours

Average speed 8.4 knots
Fuel used on trip 194 tons
Oil used on trip 859 kgs.
Cargo (incl. fuel) 4,000 tons
Mean draught 17 ft. 9 in.

"During the last voyage from Sweden," said a member of the crew, "we had very bad weather. Sometimes it was blowing a heavy gale, and it is on account of this we took so long a time for that trip." The men in the engine-room are four engineers with first-class tickets, three good experienced men named "assistants," and six other men named "motormen," but because the working hours have been shortened by law we need another man. The engineers as well as the men are well experienced in every kind of mechanical labor, and the engineers also well trained in theory about engines."

On these three voyages Mr. M. Michelsen, the guarantee engineer from the works, has been aboard, and when in New York the cylinders were opened up for the guarantee inspection. **Absolutely no trouble has been met with the engines; in fact, not 25 cents has been spent in outside repairs to the machinery since she started on her maiden voyage.**

ARDROSSAN YARD TO BUILD THREE 9,500 TON D.W. MOTOR LINERS FOR DANISH OWNERS

Just as we were going to press, we received information that contracts for three twin-screw motor liners of 9,500 tons d.w.c. have been placed by Danish owners with the Ardrossan Dry Dock and Shipbuilding Co., Ltd. Ardrossan, Scot. These vessels are each to be fitted with twin six-cylinder 1,600 shaft h.p. Diesel engines, and it is possible that the Ardrossan Company will build one pair. The other two vessels will be towed to an European port and the engines installed there.

Furthermore, we learn that a large twin-screw Diesel engine liner is being built at Messrs. Wm. Hamilton and Co., Ltd., at Port Glasgow, Scotland.

A 3,000 SHAFT H.P. WERKSPOR DIESEL ENGINE

The largest marine Diesel engine that will be built by Werkspoor during the next couple of years will be an eight-cylinder 29.92 in. bore by 51.18 in. stroke four-cycle, single-acting model. Designs of this engine, as well as a six-cylinder model of the same bore and stroke were recently completed.

SHORTAGE OF GASOLINE ON THE PACIFIC COAST A SERIOUS SITUATION

The widening gap between the production of crude-oil in California oil fields and the consumption of the manufactured products of petroleum is of considerable importance. In a new statement recently issued by K. R. Kingsbury, President of the Standard Oil Company (California), it was shown that California oil production is falling short of meeting requirements by 25,000 barrels per day. In 1919 California supplied approximately 475,000,000 gallons of naphtha products, of which gasoline is the principal one. Twenty million gallons of gasoline were imported from the East, California being unable to produce sufficient to meet the requirements of the public. In California alone the number of motor vehicles operating on the highways increased 33%, which naturally means that consumption of gasoline this year will be much greater. Mr. Kingsbury estimates that the 1920 demand will exceed that of 1919 by 25 cent. With this increased demand, and with production of crude-oil remaining where it is a shortage in naphtha products of 150,000,000 gallons this year is indicated.

The shortage in gasoline last year was relieved by bringing gasoline from the East to certain points in the Far West, which were formerly supplied with California gasoline, and which was sold at no advance in price to the consumer. Today the wholesale rates for gasoline at Eastern points of manufacture is 18 cents to 19 cents per gallon. If the deficiency in the supply of gasoline has to be made up by shipments from the East, the cost will naturally be the wholesale price plus at least 7 cents a gallon transportation charges, and a reasonable profit to the dealers.

Prices of petroleum products, like those of everything else, are subject to the law of supply and demand. In the case of gasoline on the

Pacific Coast the question of price is not the only thing; it is also a matter of getting enough gasoline to go around. In the statement from the Standard Oil Company, it is pointed out that one of the remedies in the situation is conservation, and the elimination of waste,

SUBMARINE BOAT CORPORATION AND MOTORSHIPS

According to the report of the Submarine Boat Corporation, which controls the New London Ship & Engine Co. of Groton, Conn., and the Electric Boat Co. and Electric Dynamic Co. of Jersey City, N. J., the New London Ship & Engine Co., builders of the Nelsec Marine Diesel engine, showed a net profit of \$400,330. Mr. Henry B. Carse, president of the Submarine Boat Corporation, stated that satisfactory progress has been made in the construction of a 2,000 horse-power Diesel engine, and it is planned to install the engine some time this

year in one of their vessels now being constructed at the Newark Bay Shipyard.

HARLAND & WOLFF'S GLASGOW OUTPUT

Out of 14 ships totaling 75,870 tons gross built during 1919 at Harland & Wolff's Govan and Greenock shipyards, four aggregating about 27,200 tons gross (40,000 tons d.w.c.) were Diesel-driven motorships. These were the "Glenade," "Glenariffe," "Glenue" and "Glentara," the launching of which has previously been recorded in our columns at the time of taking the water. These make a total of 14 motorships completed by Harland & Wolff, as will be seen by the list to be published in our next issue.

PRICE OF BRITISH BUNKER-COAL

The present price of British bunker-coal is about 155 shillings. No wonder a large number of motorships are now under construction in Great Britain!



The 10,000 tons d.w.c. British motorship "Glenluce," of the Glen Line. She is of 3,000 I.H.P. and of 11 knots speed, and was built and engined by Harland & Wolff

Financiers and an Economic Merchant Marine

"Motorship" Should Emphasize Advantages of Diesel Engines and Their Importance to American Shipowners

By Arthur M. Harris (of Harris, Forbes & Co., Inc., New York)

[During recent years shipowners, and financiers associated with shipowners, have not been very liberal in their assistance towards encouraging the development and production of a better "All-American" oil-engine than anything yet built abroad.

We are glad to say, however, that bankers are now paying a little more attention to the oil-engined ship, as they realize its importance to the entire trade of the country, as indicated by the visit of Mr. Arthur M. Harris, of Harris, Forbes & Company of New York, to the Swedish motorship "Stureholm." We have to bear in mind that the engine-builder can make just as much profit out of a steam-engine as he can out of a Diesel-engine, so there is little inducement for him to push the Diesel-engine construction other than his love for progress, as the resulting economies from the use of this type of power are not as much to his benefit as to the benefit of the shipowner and shipping financiers.

So it is the latter two who should finance development work. It is the liberal support of the financier and shipowner abroad that has given the Diesel-engined motorship the great success it has attained in European ships.

Had financial interests given better support to the development of an "All-American" Diesel-engine in the past, we would now have had a fleet of the finest motorships in the world in service, using America's natural oil-supply in an economic manner, and the present fuel-shortage which threatens the operation of our Merchant Marine would not have existed.—*Editor.*]

I am indebted to the Editor of "Motorship" for including me in the party that recently went aboard the new motorship "Stureholm" when she was in New York Harbor. I was much impressed with the statements made regarding the economies, such as increased cargo-space, decreased number of crew and less cost of oil-fuel to be obtained from the operation of oil-burning vessels and from Diesel engines in particular.

One of the most difficult problems of our shipping situation is the ability of American merchant-ships to compete with foreign-flag ships; however, the American merchant fleet includes a larger proportion of oil-burning ships than possessed by any other nation; and while it may be true that our ships operate under a handicap of higher wages, greater capital cost and higher insurance, I believe that fuel-cost for ship propulsion is one factor where we should gain over our competitors. The United States is producing two-thirds of the world's oil supply, and if we take full advantage of our proximity to this



MR. ARTHUR M. HARRIS

great natural resource it should serve to offset some of our disadvantages.

Shipowners have stated that the Diesel motorship is the freight-carry-

ing vessel of the world for economy and for cheap cost of operation. The Shipping Board took the initiative in encouraging the building of Diesel engines in this country, and in fact purchased last year abroad two complete sets of the larger type of Diesel engines and auxiliaries for purposes of constructive experimentation. I understand that several American shipyards have licenses to build the Diesel type of engines, and that tests and experiments are now being made. It is my earnest hope that an American type of Diesel engine will be produced as good or better than that built by any foreign nation.

As editor of "Motorship" you are in a splendid position to emphasize the advantages of the Diesel engines and their importance to American shipowners in their prospective world-wide shipping competition.

Yours very truly,

Arthur M. Harris

The National Merchant-Marine Exposition

We Welcome You At Booth No. 28—April 12th to 17th, 1920—Write Us For An Admission Ticket

So important is the coming National Marine Exposition at Grand Central Palace, Lexington Avenue at 46th Street, New York, that it is the duty of everybody interested in ships to attend and help make it the most successful exhibition ever held in the United States of America. Through the courtesy of the organizers of the Exposition, the publishers of "MOTORSHIP" are enabled to send an admission ticket to all bona-fide representatives of responsible firms who fill in the attached coupon. We reserve the right to refuse to send a ticket if our supply becomes exhausted, or for any other reason at the discretion of the organizers or ourselves.

The time has come to interest the entire nation in cargo and passenger-carrying ships,

and the greater portion of our produce and manufactures must be carried in our vessels and under the American flag. America, the

most progressive and greatest country in the world, must have an adequate merchant marine, and a navy to properly protect it.

To the Editor of MOTORSHIP
Wilson Building, 1270 Broadway
New York City

Clip This Coupon

Dear Sir:

Kindly send me one Admission Ticket to the National Marine Exposition at the Grand Central Palace, April 12th-17th, without cost to myself. I understand that a war tax of 5 cents will have to be paid on this ticket upon presentation at the Entrance to the Exposition. I hereby agree to visit this Exhibition, or in the event of unavoidable absence, to return the ticket to you prior to April 12th.

Yours very truly,

I represent, or am employed by

Name

Messrs.

Address

.....

*Give name and address of firm

Double-Acting Diesel Engines of the Motorship "Fritz"

Interesting Comments on a Marine-Engine Set Built by Blohm & Voss of Hamburg

(By the Author of the Article on the Cammellaird-Fullagar Engine)

[It is of interest to record that when the motorship "Fritz" was built it was open to any American shipowner to have purchased her and by this time to have gained most valuable experience of the type of oil-engine which seems best suited for ships of high-power, such as passenger-liners, because Blohm & Voss built her on their own account as an experiment, and for the open market.

The first pair of double-acting engines they tested and scrapped, and then built the pair now in the "Fritz." Had they originally centered all their energies upon single-acting engines such as they fitted in the "Secundus" this German firm could have easily launched the world's first ocean-going motorship; but, they sought the double-acting engine and stuck to their task with grim determination and unshaken fortitude through disappointments and other retards.

For over five years prior to the war they patiently strained towards their goal. Then, when the second pair of engines were completed and installed in the ship after tests, such as six days and nights under full-load and under intermittent abnormal temperatures, came the outbreak of hostilities and the "Fritz" was laid-up until the end of 1919 when the Allies took her away and Blohm & Voss will lose much of the merited glory for their engineering achievement as part of the price Germany is having to pay. They doubtless agree with Sherman that—"War is Hell!"

Who will be the enterprising American firm to send to Germany and secure the rights to build this unique engine in the U. S. A. or build a similar one here?—*Editor.*]

WE must admit that we were very much surprised to note that the builders of the Cammellaird Fullagar engine claimed in their description that that engine was 16% shorter for 12% more horse-power than a double-acting German-built engine of 850 B.H.P. If we had had an opportunity of seeing that German engine we should hardly have felt justified in putting that claim forward without some qualifications, as a recent inspection shows that it was perfectly obvious that no attempt whatever had been made in the German engine to save fore and aft space.

Quite the reverse is in fact the case as the crank of each cylinder is made a distinct unit and has two bearing per cylinder and there is quite a big space between each cylinder which is solely required for these bearings and the couplings; quite a lot could indeed have been saved if it had been desired, certainly more than the 16% if the shaft had been made in a single piece with only a single bearing between each pair of cranks.

We think it is important to put these facts forward before dealing with what is a very interesting engine as we had been inclined to think that there must be something inherent in the double-acting engine which necessitated great fore and aft space, whereas so far as we can see there is no reason why a double-acting cylinder should not be put into exactly the same fore-and-aft space as a single-acting cylinder of the same diameter. Presumably, therefore, the powers of the engines with which the Fullagar engine was compared should be approximately doubled if a fair comparison is to be made between the Fullagar engine and the double-acting engine.

The existing double-acting engines referred to were built by Messrs. Blohm and Voss, the big ship-builders and engineers of Hamburg to M.A.N. design and installed in a 4,300 ton deadweight capacity ship of 330 ft. in length which has recently been handed over to the British Government by the Germans under the terms of the Peace. She was, we believe, built before the war, but has been laid up ever since and was taken to England by a German crew who forthwith left her there for the British engineers to find out for themselves how to run her without leaving them any drawings or instructions to help them on their way. The "Fritz" as she is called, is in consequence still lying at Leith, while step by step investigation is being made as to how each part is constructed and functions, though good progress is being made and the engines have already been run light. She will be operated by the Glen Line.

As the power of the engines is small, namely, 850 B.H.P., two sets are installed driving twin-screws, each set having three cylinders 17½ inches diameter by 27½ inches stroke, and running at 120 revolutions per minute and these give the ship a speed of about 11½ knots.

We have never been able to appreciate that there should be any difficulty in constructing a double-acting engine provided that a suitable packing material could be found for the piston-rod gland, that the rod does not interfere with combustion and that satisfactory cooling arrangements could be made to deal with the piston which is subject to combustion temperature on both sides.

The latter we do not gather is a very difficult problem, and has been solved in this case by water admitted through pipes oscillating in glands on the scavenge-pump levers and the cross-head and then up through the piston-rod and out on the opposite side through corresponding parts. It is the gland then that is the crux and in the "Fritz" it is a beautiful piece of work. The stuffing-box is water-cooled and very deep, and contains no less than 11 sections of metallic packing with a grooved ring dividing them up so as to distribute lubricating-oil well among them.

Each section of packing consists of two rings split in halves which closely fit round the rod without springs, two rings being necessitated so as to break joint and these rings are kept close up against the rod by a spring clip-ring which is carried in a retaining ring which is clear of the rod, but a close fit in the stuffing-box; the purpose of these retaining rings appears to be to enable the packing section to be assembled before being passed over the rod. These eleven sections are entered in the stuffing-box and then simply kept in position by the gland ring, which, of course, is not used for adjustment, but simply to retain them in position.

The whole of the work in this part is very good, and the appearance of the rod is beautiful; it looks indeed as if it had just come off the grinder, and we understand there is no sign of leakage when the engine is running and this particular part of the double-acting engine difficulties has apparently been successfully overcome.

There is, however, the other point about such an engine on which we feel it necessary to express a doubt which we have been unable to solve by a study of indicator-cards or other evidence of satisfactory working and that is the efficiency of the under side of the piston. There is first of all the big diameter rod which passes right through the combustion-space and which we understand is quite cold when running and which must therefore have an unfavorable effect upon combustion. Then there are the two horizontal fuel-valves, the jet from which must pass right across the water-cooled surfaces of the piston and the bottom cover so that the combustion conditions must at least be quite different from those in an ordinary cylinder where the jet always impinges on the same comparatively small spot on the piston.

Lastly, there are the two quite small horizontal scavenge-valves on opposite sides of the cylinder and it seems almost incredible that there can be anything like a clear scavenge with such an arrangement, and there must be big pockets of inert gas left, very different from the perfect scavenge of the opposed-piston type.

We cannot help thinking that all these points must have a very bad effect upon the combustion of the fuel, and that the horse-power developed by the lower side of the piston must be very much less than that developed by the upper side, and it would require a careful study of indicator-cards, etc., before a conclusion could be arrived at as to whether the extra complication of the two additional cam-shafts, etc., is really compensated for by the added power which they give, which appears to be nothing like double that which might be expected from a single-acting cylinder of the same diameter.

We believe too that the consumption per B.H.P. is about ½ lb. per hour, which would appear to confirm our doubts. Under present circumstances and with our limited knowledge we are therefore only prepared to say that the "Fritz" does afford an example of a double-acting engine which works without any great apparent mechanical difficulties, while the value of system still requires demonstration.

Apart from this question we have nothing but admiration to express for the engines, the workmanship throughout being very excellent, and the design most substantial. The framework for instance looks almost too massive, though we are always chary of raising any objection to such a point as the strength required is very great, and consequently, if cast-iron is used the result must look, and be, heavy.

Each cylinder is mounted on two enormous cast-iron columns, the feet of which are well displayed in a fore-and-aft direction, and to add to the stiffness the tops of these columns are tied together right round by fore-and-aft, and athwartships box castings.

The cylinders too look heavy, but as cast-iron is used throughout to take the tensional-stresses this is on the right side. It is rather surprising to see no effort made to relieve the cylinder-barrel of these stresses by through-bolts, but we rather believe that the design of the engine was completed some time before the war when the point was not perhaps quite so well appreciated. The cross-head guides are fitted on the front columns, and all the moving parts, including the shoes, are lubricated by ordinary sight-feed drips, except for the crank-shaft which is fed from gravity tanks situated at the top of the engine, which therefore may perhaps be said to supply forced feed. This makes a nice open-engine of which all the parts are as accessible as on a steam engine, but for 120 revolutions per minute we hardly like to see so many little open cups about an engine, each one of which is a possible recipient of grit while it is quite a lengthy operation to make sure that each single drip is actually feeding.

Interest will undoubtedly centre around the valve-gear, and we must admit at once that we were agreeably surprised at the absence of any appearance of complication in this part, though there are three cam-shafts, two on one side of the engine, and one on the other. On the top is a single shaft for the upper valves with rockers for a central vertical fuel-valve, and for a scavenge valve on each side of it, and cams for the air starting valve.

The valves for the bottom side of the piston are horizontal and all in duplicate so that two cam-shafts are required, one on each side. The shaft in the front of the engine is driven off the same vertical shaft and skew-gear that drives the top cam-shaft, while the cam-shaft at the back of the engine requires an additional vertical shaft for itself. Here the scavenge-valves are central, while the fuel-valves are placed on each side of the centre line, and admit the fuel in a tangential stream and clear of the rod, the two fuel-valves being in opposite "corners" of the cylinder, so as to encourage a whirling action for what it is worth.

(Continued on page 330)

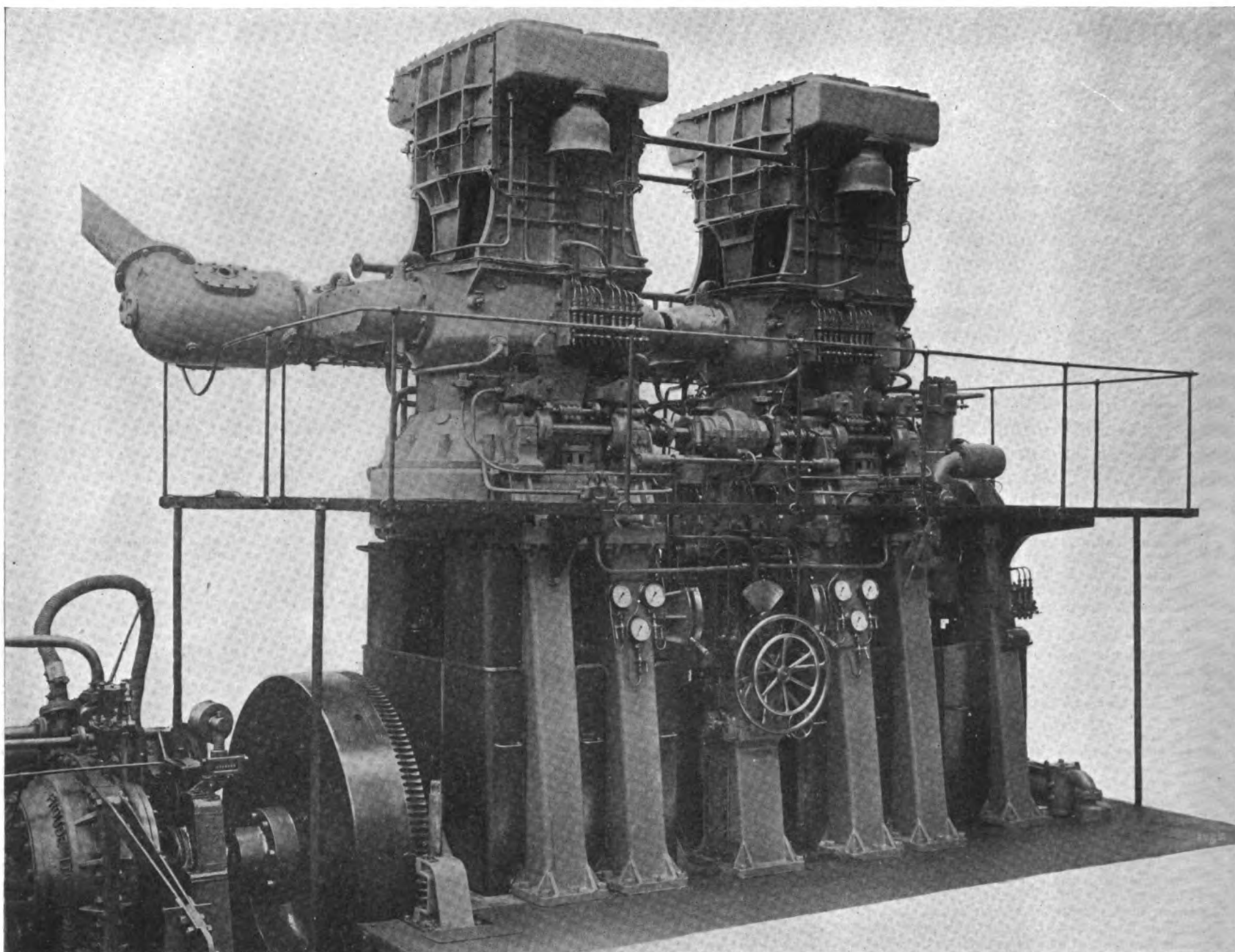


Fig. 7. The Cammellaird-Fullagar 500 shaft h.p. opposed-piston type of Diesel engine of the welded-steel motorship "Fullagar." Remarkable claims are made for this engine and several leading American shipbuilding firms are negotiating for the U. S. rights. It develops its power at 120 R.P.M. It weighs 45 tons and has an overall length of 15 ft. 6 in. and a height of 14 ft. 9 in. above shaft centers.

Cammellaird-Fullagar Diesel Marine Engine

PART II

Continuation from Last Month of an Absorbing but Practical Discussion of this Remarkable Propelling-Mechanism and its Astounding Claims

(Contributed)

(Continued from page 217 of our March issue)

Our previous remarks are the result of our cogitations in regard to this engine, but we have received from Messrs. Cammell Laird & Co., of Birkenhead, a description which embodies some really remarkable claims as to the possibilities of weight and space saving and we feel compelled to put these forward.

We note, for instance, that they claim that the opposed system as developed by them reduces the load on the main bearings by 30 per cent., a figure which is considerably less than we should have expected in view of the claims for the Doxford engine, though we quite appreciate the differences in the conditions of the two. Undeniably the pressure must be less, which is the great point. The number of bearings, too, is reduced, which from the point of view of cost of manufacture and simplification in overhaul, is of advantage, though what effect it may have on the actual conditions in the crankshaft itself, time alone will show, though probably nothing adverse if the scantlings are kept well up, while as the loads are reversible, effective lubrication is rendered easier.

The most interesting figures in the description

supplied to us are, we think, those connected with space and weight, occupied by the Fullagar in comparison with other engines, as these are to a great extent matters of fact and not of opinion and which are, therefore, more useful, at a time when no results of practical running over long periods are available. In Fig. 3 is shown the fore and aft space occupied by an existing eight-cylinder four-cycle engine of 1,550 i.h.p., compared with the Fullagar Engine of the same power, the saving in space being very nearly 50 per cent.; this amount certainly ought also to represent a big saving in weight and first cost, the builders claiming under the first heading anything between 25 and 50 per cent. depending on the conditions and without any attempt at weight cutting.

Fig. 4 illustrates the same point in another form, where (a) shows the fore-and-aft space occupied by two-cylinders of a stepped-piston type, two-cycle engine, brought as close together as strengths and surfaces in the crankshaft will allow, (b) shows the space occupied by a two piston opposed-piston unit and (c) the space for four pistons of the Fullagar. It will be noticed that both (a) and (c) allow for the scavenge-pumps, which (b) does not. Taking

the space occupied in the first case in relation to the power output as unity, the figures show that the Fullagar engine gives just double the power in 9/10 of the space, or 2.22 times the power for the same space.

We find it hard to accept these figures as applying under all conditions and all types of engines, but we are content to accept them as they are put forward by the builders as applying to the particular engines upon which the figures are based and not as a generalization; so also with the claim that a four-cycle engine with 30 in. diameter cylinders will give the same h.p. as a Fullagar engine with the same number of cylinders of only 20 in. diameter and running at the same revolution speed. Translated into different terms the claim is that a four-cycle engine with eight 30 in. cylinders will only develop 2,800 shaft h.p., against 8,400 shaft h.p. for a Fullagar with the same number and size of cylinders.

One very definite and interesting piece of information bearing on this point is given by the builders to the effect that the 1,000 h.p. engine illustrated in Fig. 1, while actually giving 12 per cent. more power yet occupies 16 per cent. less

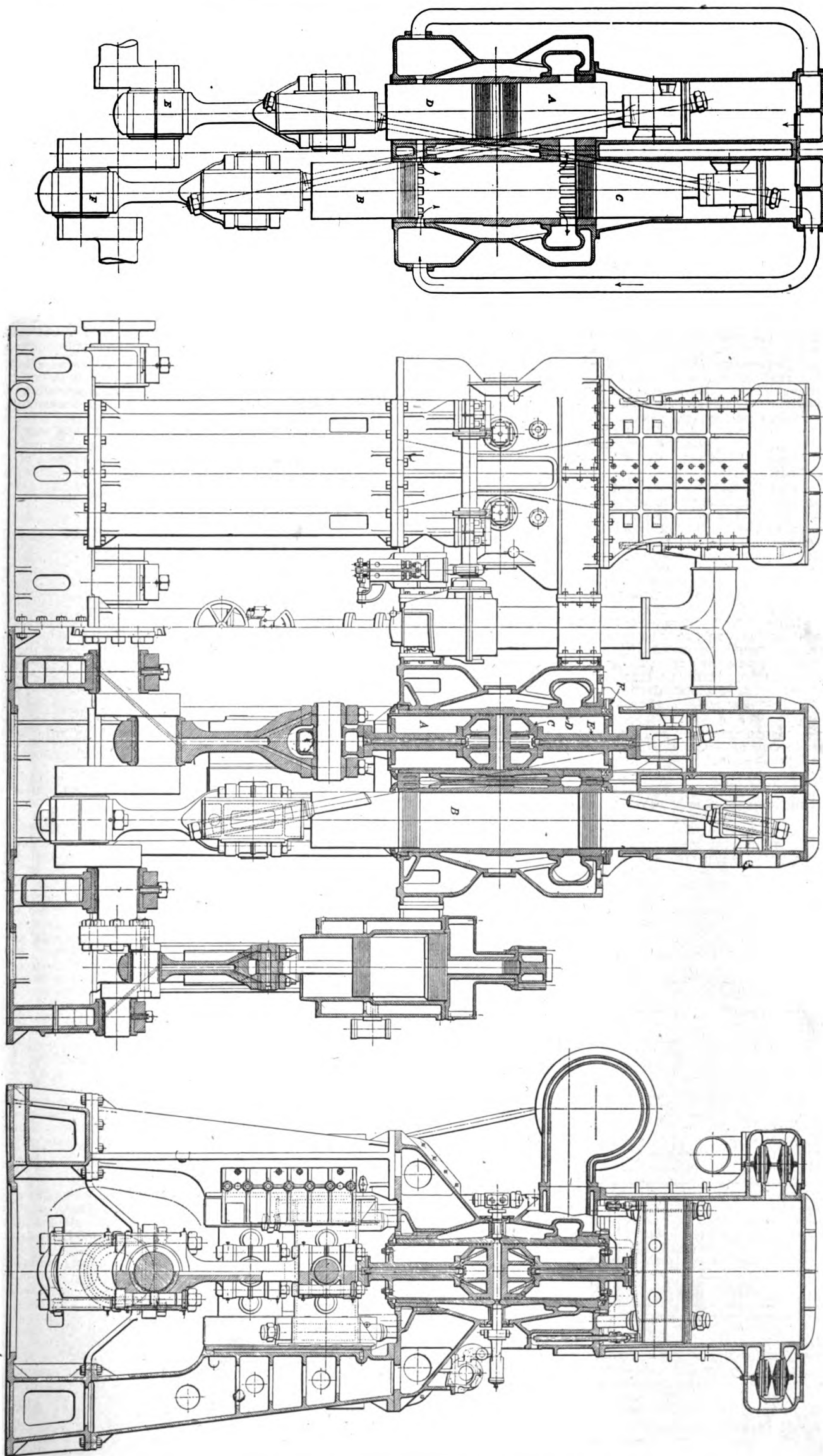


Fig. 1. The 1,000 shaft h.p. Cammellaird-Fullagar opposed-piston type heavy-oil marine engine. It weighs 91 long-tons, and is 19 ft. 9 in. long.

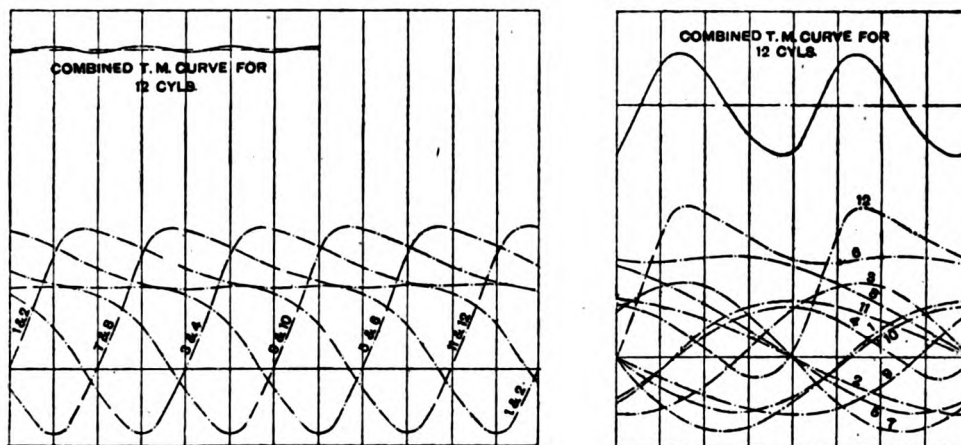


Fig. 2. Turning moments of Cammellaird and four-cycle Diesel engines.

room than a three-cylinder double-acting two-cycle Diesel engine made in Germany and fitted in a ship which is now in possession of British owners and of which full particulars are therefore available for comparison. This quite upsets our previous theories as to the only solution of the internal-combustion engine problem for large powers being the double-acting principle; though whether it would hold good if the comparison had been made with a double-acting engine of really large power is still open to question.

Then comes a claim with which we find ourselves in full agreement, though it is one which is not the exclusive property of the Fullagar but is held in common by the Oechelhauser and the Junkers. The opposed-piston arrangement actually has the effect of doubling the mean rate of expansion of the burning charge so that the piston-speed, hence the revolution speed, can be reduced. The 500 shaft h.p. engine referred to later in this article runs at only 400 ft. per minute, i. e. 120 revolutions per minute. The builders state that a 3,000 i.h.p. Fullagar engine would only have to run at about 75 revs. per minute, as against the usual revolution speed of such an engine of well over 100. The effect of this will be widely felt throughout the internal economy of the ship in the increase of efficiency in the propeller and therefore in fuel economy and also in reduced wear and tear.

The builders have gone very fully and carefully into the whole question of scavenging and have analysed the whole situation so well that we think that their notes are worth reproducing in full.

"For efficient scavenging only sufficient air should be passed through the cylinder as is necessary to enable the engine to develop its rated power. Passing any more than this is only a useless expenditure of power and affects fuel-consumption in several ways."

- (1) More oil must be burned to compress the excess air.
- (2) A slightly high scavenging-pressure is necessary to pass the excess air through the ports or valves, since the time area of these remains the same, and this again increases the waste.
- (3) Under certain conditions excess air detrimentally affects the combustion process.

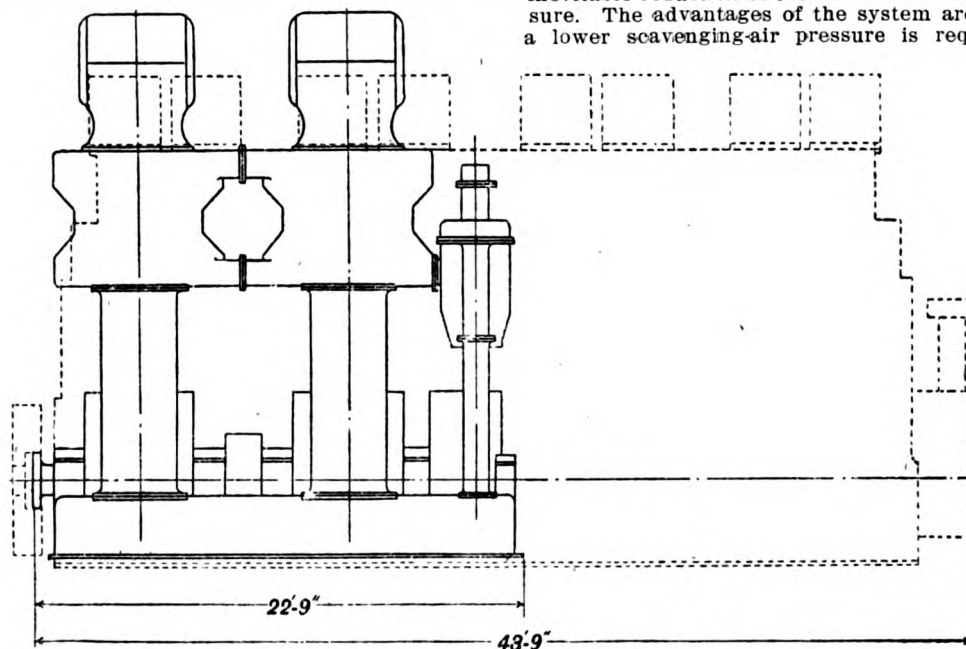


Fig. 3. Comparison of spaces occupied by Cammellaird-Fullagar and four-cycle Diesel engines of similar power.

"Fig. 5 shows the three standard methods of scavenging that are now generally common."

"(a) Valve scavenging. This is a fairly good system, the air sweeping the cylinder from end to end. The principal drawback is the restricted area through the valves for admitting the air. This gives a high air-pressure, and unless four valves are used the scavenging is rather local and turbulent, and excess air must be passed through."

"(b) Port and Valve Scavenging. This is the least advantageous of any. When the piston

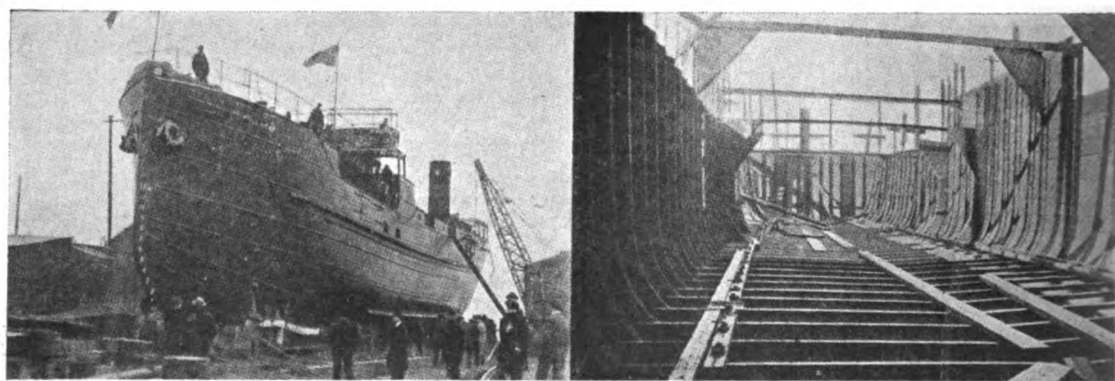


Fig. 2a. The welded-steel motorship "Fullagar." She is fitted with a 500 shaft h.p. Cammellaird-Fullagar Diesel engine.

uncovers the air-port, the cylinder gasses will fill up spaces such as "M" and these will dilute the incoming air. This, in addition to the disadvantageous position of the ports for scavenging, will entail the compression of a large excess of air to obtain the same purity of charge as with "A." Also the exhaust ports with this system are long, amounting in some cases to 30 per cent. of the piston stroke. This reduces the effective working stroke and also the amount of air remaining in the cylinder after the ports are closed, resulting in the inevitable reduction of the effective mean pressure. The advantages of the system are that a lower scavenging-air pressure is required

than with system (a) and fewer valves are required in the combustion-chamber, thus simplifying the cylinder-cover."

"(c) In the new engine the air is admitted round the whole circumference of the cylinder, so that the scavenging is even and regular, and carried out at a low pressure, all of which combine to give efficient scavenging with a minimum of turbulence. This system possesses the advantages of systems "A" and "B" without the disadvantages. The exhaust-ports need only be one-third the length of ports required by "B" and this makes the effective working stroke a maximum and reduces the loss of air by way of the ports to a minimum. The whole circumference being available for air ports it is possible to get five times the area that can be obtained with valve scavenging. The effect of this is that scavenging can be done with a pressure of only $1\frac{1}{2}$ lbs. per square-inch for the slow-speed engines, and about $2\frac{1}{2}$ lbs. for the high-speed type. The scavenging-pumps indicate less than 4 per cent. of the engine power, which is a considerable improvement over other two-cycle engines."

"There is also a large volume of air round the belt ready to enter the cylinder as soon as the piston uncovers the air ports, whereas with valve scavenging the passages in the cover and pipes are cramped and the air has to come a long way. The relative efficiency of the two systems is clearly shown by the indicator diagrams of Fig. 6. Diagram "A" is from the scavenging pump of a valve scavenging engine, and diagram "B" from the pump of the new engine, "A" showing nearly three

times as much work as "B."

"With the exception of the opposed-piston engine, it is probable that the four-cycle engine has a more efficient scavenging system than the two-cycle one. With the four-cycle motor the scavenging is carried out at atmospheric pressure and little or no power is absorbed by the air. It has to be done, however, at the cost of the frictional losses of two whole working-strokes of the main engine pistons. It can be shown that the power lost in these two idle strokes is less than that absorbed in compressing the scavenging air by some two-cycle systems, and this fact practically accounts for the generally recorded higher fuel consumption of the two-cycle engines."

So much for the generalities and an outline of the *modus operandi*, but things often look very different on paper from what they do when they come to be carried out in practice. In the Fullagar engine, however, this is not the case and the engine quite follows the above outlines so that the drawing of one of two sets which Messrs. Cammell Laird & Co. have under construction (which we are enabled to publish as Fig. 1) will be easily followed as far as its main features are concerned. The engine in question is a four-cylinder, or rather two unit machine, as it will almost become necessary to call this type, with cylinders of $18\frac{1}{2}$ in. diameter, each piston having a stroke of 25 in., and giving about 1,000 shaft h.p. at 110 revolutions per minute.

Fig. 7 shows a photograph of a smaller engine which has already been built and run, the cylinders of which are 14 in. diameter, each piston having a stroke of 20 in. This engine gives 500 shaft h.p. at 120 revolutions per minute and has been exhaustively tested in the shop, including a run for a week at full-load without any stop. We have not been given any figures of consumption, mechanical efficiency, blast-air pressures and so on, which are always so interesting in discussing the Diesel engine, but we see no reason why these should not be just as good as those of other two-cycle Diesel engines and we hope that the figures may be available at a later date.

[The fuel-consumption of the 500 h.p. engine is 0.42 lb. The engine has a weight of 45 long-tons and is 15 ft. 6 in. long overall, with a height of 40 ft. 9 in. above shaft center. It turns at 120 R.P.M. The 1,000 h.p. engine weighs 91 tons, has a length of 19 ft. 9 in. and a height above shaft center of 19 ft. 3 in.—*Editor.*]

So far as outward appearances go, the engine is quite distinctive and like no other that we can recall except the Junkers, as there are no valves or rockers on the tops, while the camshaft looks as if it was at the bottom of the cylinders. Otherwise there is nothing to indicate what it is, as the diagonal-rods which are its really exclusive features are all enclosed and we will deal with the details of this part first.

as efficient as an ordinary scavenge-pump, as the pressure dealt with is very low and the area for leakage at the corners is only 0.000002 of the total pump area. Straight brass bars, of course, have to be fitted instead of ordinary spring rings.

We confess that we should have been quite prepared to wink at a very considerable loss of efficiency in this pump when it is considered that the only additional loss of mechanical efficiency which it entails is the friction of the bars and the work necessary to compress air to a pressure of only $1\frac{1}{2}$ or 2 lbs. per square inch, while the actual additional parts are the piston, with its spring-bars and the valves and the cover and two side-plates which go to complete the cylinder.

With a view to emphasizing the contrast between this and other arrangements our readers

back plate of the pump must be taken off and the piston placed in its upper or "out" position; the piston-rod must then be disconnected from the crosshead and the skirt and the extension piece F disconnected from the cylinder. The skirt is then lifted by a neat little crane like that fitted in the Werkspoor Diesel engine for taking the piston out from below and the piston rod can then be disconnected from the crown. Then the skirt, piston-rod and extension-piece can be lifted out sideways and the crown removed.

It will be appreciated that any arrangement for drawing the piston as a whole out upward is complicated by the fact that it would also have to be moved laterally to accommodate the diagonal hole in the crosshead and it is probably much better to leave that part untouched when it is running

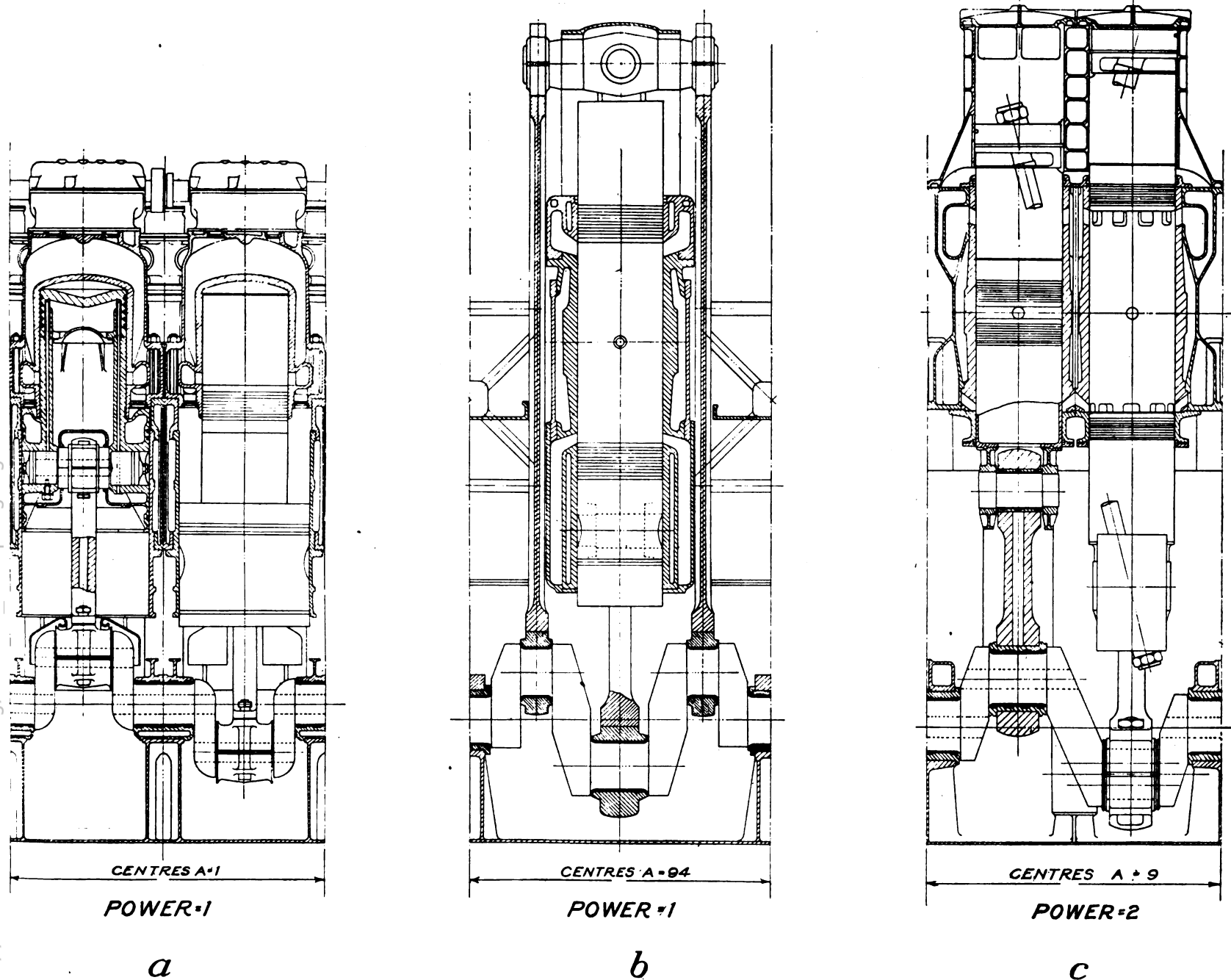


Fig. 4. Comparison of fore and aft spaces occupied by three types of two-cycle Diesel engines, the Cammellaird-Fullagar being on the right.

We would begin by expressing our appreciation of the clever way in which the upper guides of these rods have been turned to a more useful purpose than that of merely absorbing friction. As will be seen from Fig. 1 the pistons are formed in three parts, a crown C carrying the rings, a skirt D, and a piston-rod E. The latter projects beyond the skirt and is bolted to a crosshead to which the diagonal-rods are attached and which has guide-bushes back and front to take the thrust.

Even this is, of course, a more economical method of obtaining power than if the piston had its own connecting-rod and crank, but still further economy is got out of it by enclosing the sides and top of the guides and fixing a square piston on the top of the crosshead and this by means of ports and valves in the head as shown forms a very effective and cheaply gained scavenge pump.

A square cylinder is a novel method to us of obtaining a pump and one which we should have expected to be quite indifferently efficient. We are informed, however, that it is really every bit

may be reminded that in the Sulzer engine of the "Sabara" ex "Monte Penedo" the scavenge-pump consists of a big extra cylinder with its connecting and piston-rods and crank and a big valve driven by a set of marine-type link-gears for reversing the valve and this increased the length of the engine by over 30 per cent. The only arrangement with which the Fullagar pump is in any way comparable in regard to space occupied is, to our mind, the Nurnburg (M.A.N.) stepped-piston, which is used as a scavenge-pump, but this makes for inaccessibility and is only applicable to the trunk-piston design without increasing the height of the engine to an almost prohibitive amount beyond that actually necessary for the operation of the requisite parts. The Fullagar pump takes no additional space, adds only an infinitesimal amount of weight and introduces no additional parts to require attention beyond the spring bars and the valves.

It really looks as if the arrangement were beyond criticism, as it in no way increases the difficulty of dismantling beyond that inherent in the Fullagar design. To remove an upper piston the

all right, even if it does entail (which we do not say that it does) the slacking back of one or two more nuts. The method adopted will, we believe, compare favorably with any other means of taking out pistons so far as time occupied is concerned, and it requires the breaking and remaking of no high pressure joints.

Each upper crosshead is converted into a pump and serves one cylinder of a unit, the air passing from the valves down through a vertical pipe and so to the scavenging-ports. Another very nice little point may be dealt with here as being connected with the cooling of the piston for which oil is used. In the B. & W. engine "Selandia" oil was admitted to the piston from the forced feed to the crankshaft and up through the connecting-rod and piston-rod and after passing through the piston was thrown out through the crosshead on to the guide.

Here we might almost say that the process is reversed and oil is actually admitted by means of the guides in the case of the lower piston. For this purpose a slot is formed in the face of the

ahead guide-shoe opposite to a hole in the guide which is connected to the oil supply and thus oil can pass from a stationary part to a moving part without any loose or additional parts and with no friction and with very little leakage, as the pressure on the guide face should be sufficient to ensure tightness and anyway leakage would not matter if confined within reasonable limits. It will, of course, be realized that the guide-shoe must be longer than the stroke of the piston so that the

necessity which is now becoming well recognized in Diesel-engine design. The crossheads of the lower pistons are of the usual marine type, but a shoe is formed on the side which slides on a plate projecting from the face of the main guides to take the thrust of the diagonal-rod and these main and auxiliary guides are carried on cast-iron columns in the ordinary way.

It will be seen that the bedplate remains of the normal steam-engine type instead of being of the

the wheel puts two fuel-valves into gear, leaving two air-valves unaffected and the third position cuts out the air-valve and puts all four fuel-valves into action, further regulation of the speed being controlled by the lift of the fuel pump suction valves with an Aspinall governor to deal with racing. Attention should be called to the careful arrangements which have been made to prevent the possibility of the fuel-valve producing distortion on the cylinder liner when the latter is heated up.

The auxiliaries are all arranged at the forward end of the engine, including the water and lubricating-oil pumps and the three-stage air-compressor, which is driven by a connecting-rod and crank so that the whole engine is self-contained. In view of almost constant troubles which are reported in connection with air-compressors we are

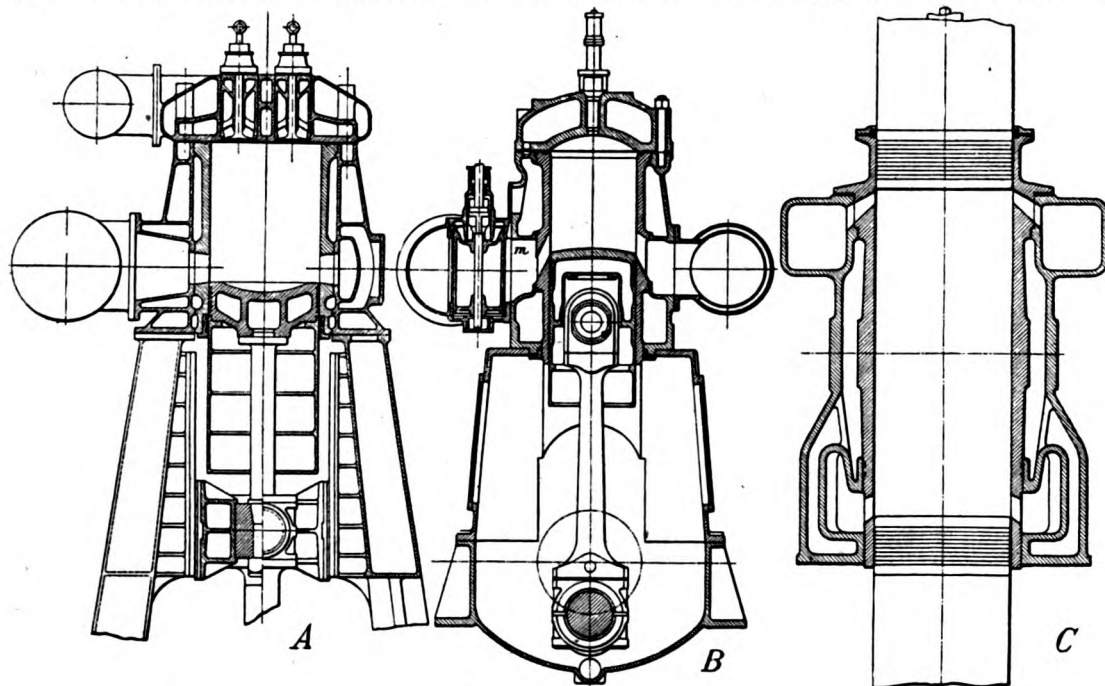


Fig. 5. Scavenging systems of three types of two-cycle Diesel engines.

lubricating admission-hole may not be uncovered.

It is a great pity that some such delightfully simple scheme cannot be employed for water which, it would appear from recent experience, seems to be necessary for cooling the piston of larger engines, as some Diesel engines have failed entirely in this point alone and it is rare to come across any engine which has had no trouble in this direction. In the case of the upper piston a telescopic-tube is fitted in a flexible connection for the oil inlet as shown in Fig. 1, the outlet passing through a down tube which has a clearance between it and the receiving tube. One other piston detail—the extension piece "F" has a groove formed on its inside and this is connected to the scavenging-pump so that any leakage of exhaust-gases past the rings cannot escape into the engine-room but is drawn into the engine.

The remaining features of the engine do not demand a great deal of attention, as they are less out of the usual run. The drawing shows how the cylinders are mounted on an entablature and coupled together at the top by a cast-iron box-girder which makes a good fore and aft tie, a

usual deep girder form found in Diesel engines, and this is, of course, rendered possible by the fact that the combustion-pressure reactions are taken up by the opposed pistons. The camshaft is, of course, in the centre of the length of cylinders and is driven by the vertical shaft and skew gearing, so common in European Diesel engine practice.

Reversing is accordingly effected in the usual manner by lifting the skew-gear with the vertical shaft and so rotating the camshaft through a small angle so as to vary the time of opening of the fuel-valve. As the pistons act as the exhaust and scavange valves, there are only the fuel and air-starting valves to deal with in reversing and only a single cam is required for each per cylinder, so that the gear is of the very simplest. Two wheels are employed, one to lift the skew-gear and, as this is counterbalanced, this requires no great amount of labor. The second wheel puts the starting-air valves and the fuel-valves in or out of gear in consecutive steps.

The first position puts all the air-valves in gear and all the fuel-valves out of gear to get the first turn out of the engine. The next movement of

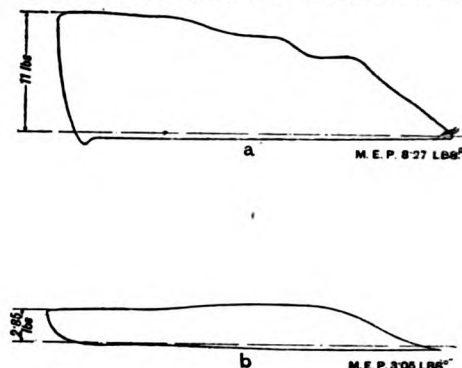


Fig. 6. Indicator diagram from Cammellaird-Fullagar Diesel engine.

glad to note that accessibility to this part has received very careful consideration and it is only necessary to remove a small plate, without dismantling anything else, in order to get at any of the valves. It appears to be becoming the universal practice to fit a separate fuel-pump for each cylinder and this is followed in this case.

We will conclude by mentioning one arrangement which struck us as being very useful as tending to please more particularly the man on duty below. A metal panel is fitted close to the starting platform to which connections are brought from all the air-bottles and which carries all the gauges and control-valves so that the engineer does not have to leave his place in order to alter his connections either to fill up his running air-bottles or make any other interconnection in his compressed-air service.

We have always felt very strongly that the greatest consideration should be given to the man who has to look after Diesel engines and that all the movements necessary should be as simple as possible, and the levers arranged as handily as is feasible.

Finally, we must admit that we are very much taken with the design and we hope that the results of continued daily service at sea will be such as to confirm the anticipations of the builders and to lead in the near future to the provision of Diesel engines of larger powers than there appears to be any immediate probability of obtaining in other directions.

BASIL H. JOY.

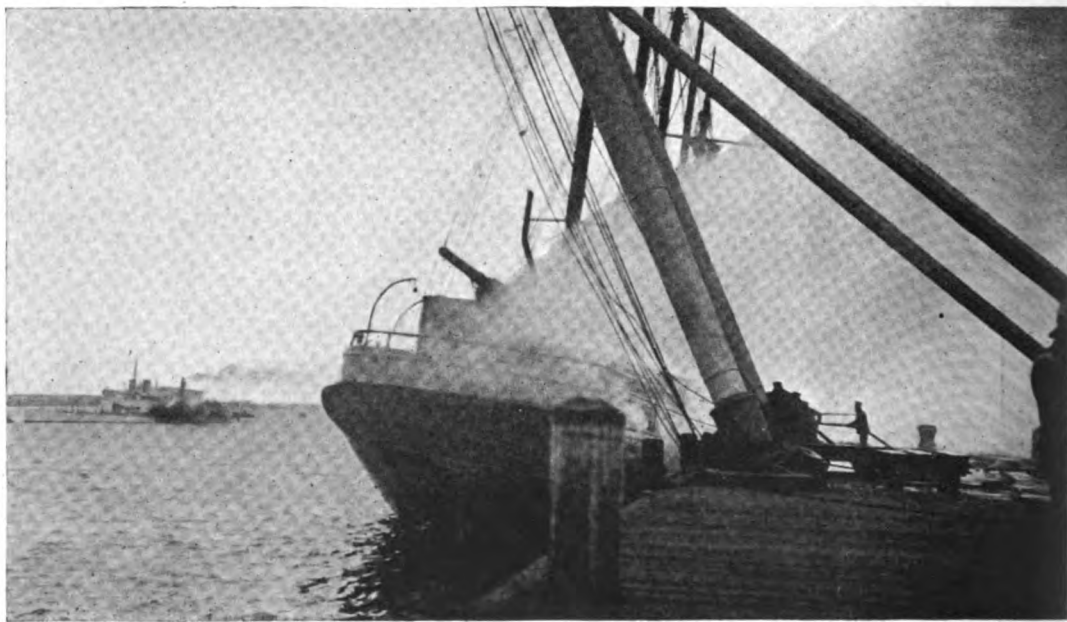
FIGHTING FIRE AT THE DOCKS IN SHANGHAI (Delayed)

When a vessel visits a port where shipping facilities are not of the best, an accident often taxes to the utmost the resourcefulness of those responsible for the safety of the ship. Even in an up-to-date and fully equipped port a fire on board ship may result in serious loss. The photograph on this page illustrates an incident which occurred when the motor-schooner "Stasia" was threatened with total destruction by fire at the Cosmopolitan Dock, Shanghai, China. Our correspondent writes us that the "Stasia" had arrived from Vancouver, B. C., a week previous to the time the fire started in her engine room. A gang of Chinese fitters were working there and upset a kerosene lantern which they were using. Little need be said of the danger accompanying the use of this method of illumination, or of any naked flame around the engine room. Some accidents are unavoidable, but to invite trouble of such a serious nature is foolhardy.

The vessel shown in the stream is the British river-gunboat "Gnat." She has just fired a solid shot at the "Stasia," and the smoke can be seen rising from one of her six pounders. It was by this means that the "Stasia" was flooded and the fire got under control. She is owned by Pierre-Legonque, French interests, and is a five-masted auxiliary schooner built in 1917 by Cameron-Genoa Mills, Ltd., at Victoria, B. C. Her dimensions are,

length, 245 ft. 4 in.; breadth, 43 ft. 9 in.; depth, 21 feet; gross tonnage, 1,565. She is powered with

twin 120 b.b.p. Bolinder surface-ignition heavy-oil engines.



Motor Schooner "Stasia" on fire at docks, Shanghai, China

Development of the Opposed-Piston Marine Oil-Engine

Resumé of Past Progress with this Type of Diesel Motor

ONCE more the opposed-piston type of marine heavy-oil engine is in the limelight, and is holding the attention of the shipping audience, several large shipbuilding and engineering firms having undertaken its construction, and in one case the cylinder output is larger than any other marine Diesel-engine under construction. The type of engine is of special interest to domestic shipowners and shipbuilders because American financial interests have undertaken its construction, a syndicate having acquired the rights from the Government and have a large engineering plant undertaking its construction. The company has been at work very quietly for some time and now is ready to book and carry out orders.

During the period of 1889-1894 experiments with opposed-piston internal-combustion engines were undertaken in Germany by Professor Hugo Junkers and Herr Von Oechelhauser. These experiments showed great promise for 2-cycle operation with an opposed-piston oil-engine. They were continued and an experimental 100 h.p. engine was completed and put in operation in 1892. This engine was closely watched and studied, with the result that a 200 h.p. engine of this type was designed and put into service in 1908 at Aachen, Germany.

The next step in the development of the opposed-piston engine was the design and building in the years 1910 and 1911 of a 1,000 h.p. horizontal motor, which was installed at Aachen, Germany, and used there as an experimental and demonstrating engine up to the fall of 1914, at which point our information ceases, except that during the war the Deutsche Oelmaschinen G. M. B. H. secured the German marine rights. This company was formed by the A. E. G. and the Hamburg-American Line.

During the development period a considerable number of basic patents were taken out covering the construction and operation of this type of engine in foreign countries and in the United States. In 1915, a corporation called the American Junkers Company was organized under the laws of the State of New York for the purpose of purchasing U. S. patents and rights and for the further purpose of licensing manufacturers to build the opposed-piston oil-engine under shop-rights agreements. Conditions incident to the war crippled the operation of this company and negotiations entered into were broken off or lapsed with the exception of the shop rights granted to the Super-Diesel Tractor Corporation.

Later on, when the United States entered the world war, and enemy property began to be confiscated by the United States, the stock of the American Junkers Company, together with the patents owned by this company, were seized by the United States, and custody taken by the Alien Property Custodian. This property was advertised for sale in the spring of 1919, and on April 23, 1919, the stock of the company and all of its assets and liabilities were sold at public auction to a syndicate formed for that purpose. The patents purchased control the construction and

operation of the 2-cycle opposed-piston oil-engines in the United States, together with the construction of numerous auxiliaries.

The above mentioned syndicate has been instrumental in reorganizing the American Junkers Company and in changing its name to the Opposed Piston Oil Engine Company, Inc. The new company has its office at 511 Fifth Avenue, New York, and is now engaged in the further development of this type of engine and in the sale of shop rights for the United States. Considerable progress has been made and numerous additional patents have been added to the already rather complete patent protection. The Super-Diesel Tractor Corporation of Laporte, Ind., has been licensed to exclusively manufacture farm tractor engines of the opposed-piston 2-cycle type and further licensed to manufacture non-exclusively engines of 40 h.p. or less for farm purposes.

Prior to the world war, namely in the years 1912 and 1913, the following companies purchased licenses and shop rights for the manufacture of the opposed-piston oil-engine in other parts of the world:

Gebrüder Klein, Dahlbruch, Germany—Standard river and lake boats.

A. G. Weser, Bremen, Germany—Stationary and mercantile marine.

J. Frericks & Co., Osterholz, Germany—Mercantile marine.

Sormowo Works, Nisyn-Novgorod, Russia—Stationary and mercantile marine.

Wm. Platz Sons Co., Weinheim, Germany—Stationary.

Ehrhart & Sehmer, Saarbrücken, Germany—Stationary.

Wm. Doxford & Sons, Ltd., Sunderland, England—Mercantile marine.

Emanuel (Ludwig?) Nobel, Petrograd, Russia—Mercantile marine; river and lake boats.

Dujardin et Cie, France—Stationary, etc., etc.

In the year 1913, some 32 engines of the opposed-piston oil-engine type were manufactured by the various Junkers licensees, ranging in size from 27 h.p. to 1,000 h.p.

About 1913, Professor Hugo Junkers built a factory at Magdeburg, Germany, for the purpose of manufacturing these engines for commercial purposes. This factory's production ranged in size from 50 to 550 h.p., and these engines were sold in various countries, quite a number being sold in Russia and put in operation in 1914. Engines built by the Junkers licensees are shown in the photographs herewith. About this time plans were made for the manufacture of locomotive engines with opposed-piston oil-engines.

Prior to the war and during the war, Wm. Doxford & Sons, of Sunderland, England, prosecuted their development work for the manufacture of opposed-piston 2-cycle oil-engines for the mercantile marine. This work has resulted in the building of 2,400 and 3,000 h.p. engines for cargo-ships, and, according to their publicity announcements, in the booking of orders of some 45 ships so engined.

Incidentally, the design developed by the Wm.

Doxford & Sons Co. includes the injection of fuel into the cylinder without the use of blast-air. For this purpose the fuel-oil is placed under considerable pressure, and by means of a valve of special design is introduced into the cylinder in a finely divided condition. This disposes successfully of the high-pressure air-compressor for blast purposes, and makes it necessary to use only the auxiliary air-compressor for filling the starting air bottle.

The work is just beginning in the United States, where it is hoped that the development may be pushed intensively, so as to make up the time lost during the war by inaction of the American Junkers Company. The advantages claimed for the opposed-piston 2-cycle oil-engine are:

- a: Two-cycle operation as opposed to four-cycle operation, thus giving one power impulse for each revolution of the crank-shaft as against one power impulse for each two revolutions of the crank-shaft as obtained with the older Diesel construction.
- b: Lighter weight on account of the more frequent power impulses per cylinder.
- c: The application for practically all of the explosive and expansive effort of the fuel to the crank-shaft through the opposed-piston construction.
- d: Relief of the cylinder and the cylinder supports from all stresses except radial stresses due to the explosion of the fuel, and except the gravity stresses.
- e: The almost complete balance of the inertia forces and the balancing of the crank-shaft without counterweights.
- f: Perfect scavenging due to the small diameter of the cylinder as compared with the long combined stroke, and also due to the method of introducing the fresh cool-air for scavenging and recharging the cylinder.
- g: The omission of valves, valve-gears, valve-seats and other valve-mechanism.
- h: Reduced cost to manufacture per h.p. due to the reduced number of parts and the simple form of the parts, and to the greatly reduced weight of the parts per h.p.
- i: A marked reduction of vibration due to the negligible values of the unbalanced forces.
- j: A reduction in the number of main-bearings for the crank-shaft and the greatly decreased wear on these bearings owing to the balanced method of yoking the pistons to the crank-shaft.
- k: Greater continuity of power effort transmitted to the crank-shaft resulting from 2-cycle operation and opposed piston arrangement.

The new American company has entered the field at an opportune time, since not only the engineering profession, but the man in the street as well, is convinced that the oil-motored cargo-ship is the only one which can survive in a competitive market, owing to the well-known savings made by internal-combustion power; in fuel cost; in operating force; in bunker space; in cargo space and in time.

Otto and Thor Thoresen Order Two More Large Motorships

A Total of 13 Diesel-Driven Vessels on Order for this Norwegian Company

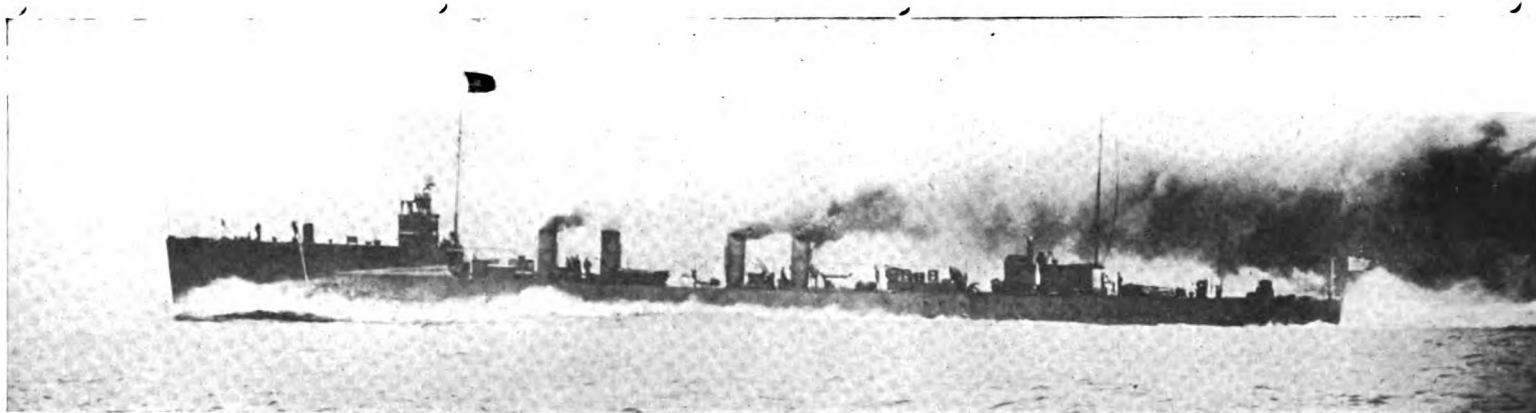
In addition to the 11 motorships stated in our March issue to be building for the Otto & Thor Thoresen Line, of Christiania, Norway, two additional Diesel-driven cargo-vessels of 6,500 tons each have just been ordered by this important shipowning company from a shipyard at Ardrossan, Scotland. The Diesel engines for the same will be built by Hawthorn, Leslie & Co., Ltd., Hebburn-on-Tyne, England, who have secured a Werkspoor constructional license.

In eight of these new motorships Werkspoor Diesel-engines will be installed and five will be equipped with Burmeister & Wain Diesel engines. All will be of the four-cycle type. This makes a total of 25 ships, aggregating 110,500 tons d.w.c. now on order for this firm, the others

12 being steamships. Until recently Otto & Thor Thoresen ran separate lines, but they now have been consolidated, and have a total capital of 24,000,000 kroner. The name of the new company is Otto Thoresen & Thor Thoresen Aktieselskabet.

Regardless of the remarkable way in which European shipowners are ordering motorships the majority of American shipowners have failed to fully appreciate the "writing on the wall," and about 1,000,000 tons of uneconomical steamships are now on order in American yards for private ownership. All are oil-fired and will require such a huge quantity of oil-fuel that the present shortage conditions will be brought to a more serious stage, a state of affairs that has been encouraged by the past actions of the U. S. Shipping Board.

—And American Shipowners Still Slumber in Perfect Bliss!



One of the U. S. Destroyers now being converted to Diesel-driven passenger vessels.

Converting Destroyers to Diesel-Engined Passenger-Ships

Novel Undertaking by the New London Ship and Engine Company

One of the most interesting projects of the year will be the conversion of four turbine-driven destroyers into Diesel-driven passenger-vessels and private pleasure motor-craft. These vessels, lately the "Reid," "Flusser," "Lamson" and "Preston," late of the U. S. Navy, were built in 1909, were recently sold, but their hulls are in first-class condition, and will need but little repair work to make them ready for the conversion.

They have been purchased by the New London Ship and Engine Co. of Groton, Conn., builders of the Nelsec naval and commercial types of Diesel-engines, with the above idea in view. Their dimensions are as follows:

Length (O. A.)	293 ft. 10 in.
Beam	26 ft. 0 in.
Mean draft	8 ft. 0 in.
Displacement (normal)	700 tons
Full-load displacement	900 tons
Designed speed	28 kts.

Maximum speed attained on trials about 30 kts.

The staunchness and seaworthiness of these vessels were demonstrated by their continuous operations in the war zone during the late war, during which service they were never forced to put into port by stress of weather, though frequently employed in the winter season in the Bay of Biscay, which is notorious for bad weather.

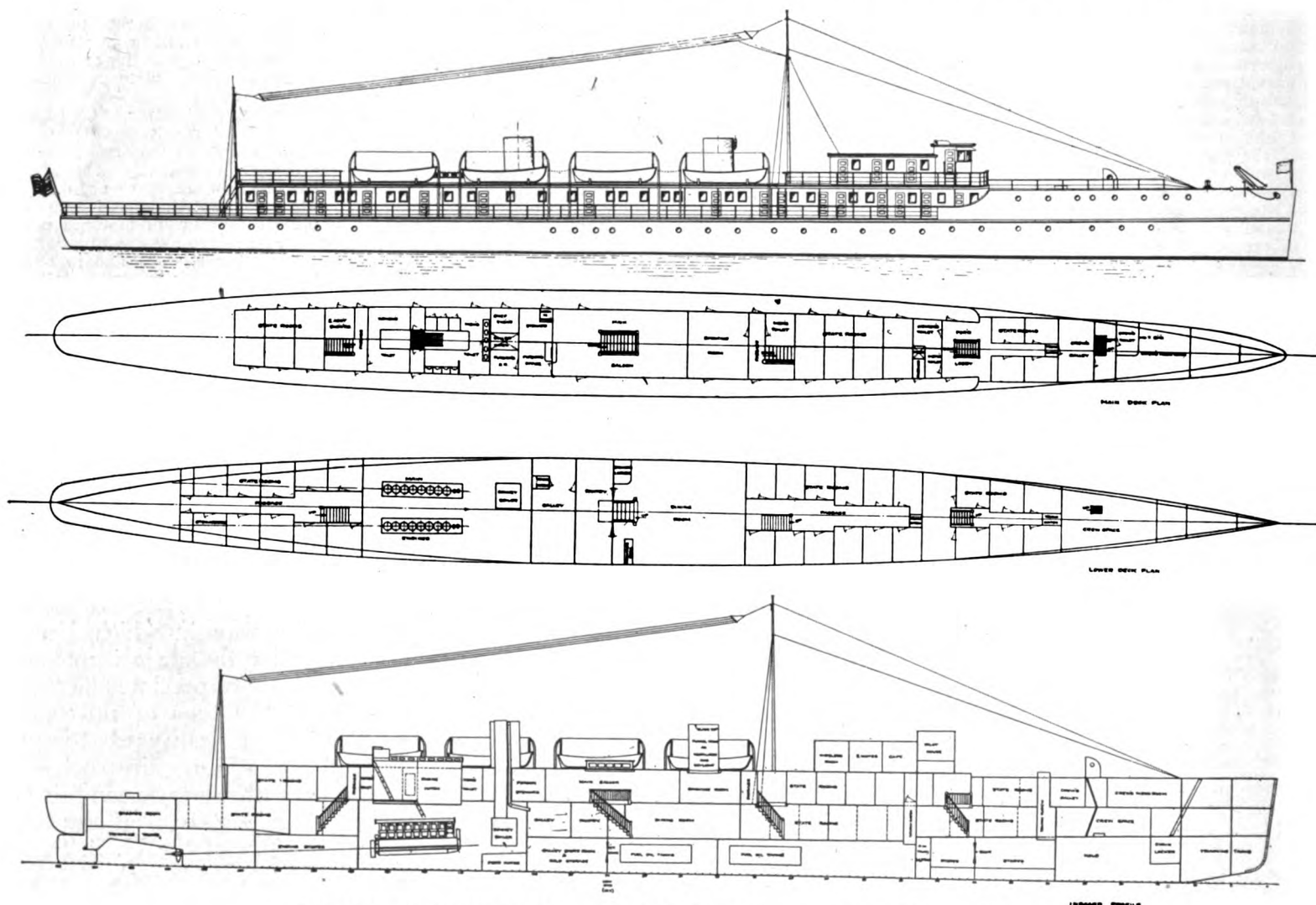
As originally built these vessels were equipped with small tube boilers and Parsons turbines, driving three screws. The New London Ship & Engine Company contemplates removing the engines and boilers and replacing them by Nelsec Diesel-engines of reduced power. This will result in a great saving of space and weight, which will be available for passenger accommodations. The extent of the saving can be judged from the following data:

Weight to be removed (engines and boilers and accessories)	367 tons
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Weight to be added (Diesel engines, donkey boiler and accessories)	241 tons
Saving	126 tons
Length of boiler and engine-room spaces, turbine installation	133 ft.
Length of engine-room, with new Diesel installation	40.3 ft.

An even greater saving might be effected in a new design, but for structural reasons it is desired to preserve the original bulkheads unchanged, which results in a larger engine-room than is strictly necessary. We presume that there is a saving in boiler-water space and weight, and the same with regard to the fuel bunkers, but of which no definite mention is made.

So much has been written in regard to the saving in cost of operation of vessels propelled by Diesel-engines over that of steam-propelled vessels of equal power that it is perhaps unnecessary to expatiate upon it in detail. Figures are given below, however, for four typical installations, com-



Passenger motorship No. 1 as she will look when converted to Diesel power.

pared with steam plants of equal power. As the present abnormal price of coal and labor has given an impetus to oil-fuel for firing boilers, comparisons are made with both an oil-burning and coal-burning installation. It should be pointed out that this comparison does not tell the whole story, as engines and boilers and extra crew's space would seriously cut into the space available for passengers—a serious matter on vessels with fine lines and adapted to high speeds.

pilot-house, with quarters for captain and mates, and a wireless-room is built on top of the forward end of the deck-house. On the lower deck in the night boat are state-rooms forward and aft, with dining-room, pantry and galley amidships, the dining-room communicating with the main-saloon. In the day boat the number of state-rooms is reduced, and the dining-room increased in size, while a cargo space is provided forward. In the hold are general stowage space, storerooms and

Installation A—Two 480 H.P. engines.
Corresponding speed 15 knots.

	Coal-Fired Steamship	Oil-Fired Steamship	Motorship
Total shaft horsepower.....	960	960	960
Normal fuel-capacity	30 tons	8000 gals.	8000 gals.
Radius of action at full speed.....	450 miles	680 miles	1700 miles
Fuel consumption per hour at full speed.....	1 ton	177 gals.	71 gals.
Fuel consumption per mile at full speed.....	150 lbs.	11.8 gals.	4.7 gals.
Radius of action at 12 knots speed.....	640 miles	960 miles	2400 miles
Fuel-consumption per hour at 12 knots speed....	1260 lbs.	100 gals.	40 gals.
Fuel consumption per mile at 12 knots speed....	105 lbs.	8.3 gals.	3.3 gals.
Engineer force—engineers	4	4	4
—oilers	3	3	3
—wipers	0	2	2
—firemen	6	3	0
—coal passers	3	0	0
Total	16	12	9

Installation B—Two 700 H.P. engines.
Corresponding speed 16.7 knots.

	Coal-Fired Steamship	Oil-Fired Steamship	Motorship
Total shaft horsepower.....	1400	1400	1400
Normal fuel-capacity	30 tons	8000 gals.	8000 gals.
Radius of action at full speed.....	345 miles	520 miles	1300 miles
Fuel-consumption per hour at full speed.....	1.45 tons	257 gals.	103 gals.
Fuel-consumption per mile at full speed.....	195 lbs.	15.4 gals.	6.2 gals.
Radius of action at 12 knots speed.....	640 miles	960 miles	2400 miles
Fuel-consumption per hour at 12 knots speed....	1260 lbs.	100 gals.	40 gals.
Fuel consumption per mile at 12 knots speed....	105 lbs.	8.3 gals.	3.3 gals.
Engineer force—engineers	4	4	4
—oilers	3	3	3
—wipers	0	2	2
—firemen	6	3	0
—coal passers	3	0	0
Total	16	12	9

Installation C—Two 1000 H.P. engines.
Corresponding speed 18.7 knots.

	Coal-Fired Steamship	Oil-Fired Steamship	Motorship
Total shaft horsepower.....	2000	2000	2000
Normal fuel-capacity	30 tons	8000 gals.	8000 gals.
Radius of action at full speed.....	280 miles	420 miles	1050 miles
Fuel consumption per hour at full speed.....	2 tons	356 gals.	143 gals.
Fuel consumption per mile at full speed.....	240 lbs.	19 gals.	7.6 gals.
Radius of action at 12 knots speed.....	640 miles	960 miles	2400 miles
Fuel-consumption per hour at 12 knots speed....	1260 lbs.	100 gals.	40 gals.
Fuel-consumption per mile at 12 knots speed....	105 lbs.	8.3 gals.	3.3 gals.
Engineer force—engineers	4	4	4
—oilers	3	3	3
—wipers	0	3	3
—firemen	9	3	0
—coal passers	6	0	0
Total	22	13	10

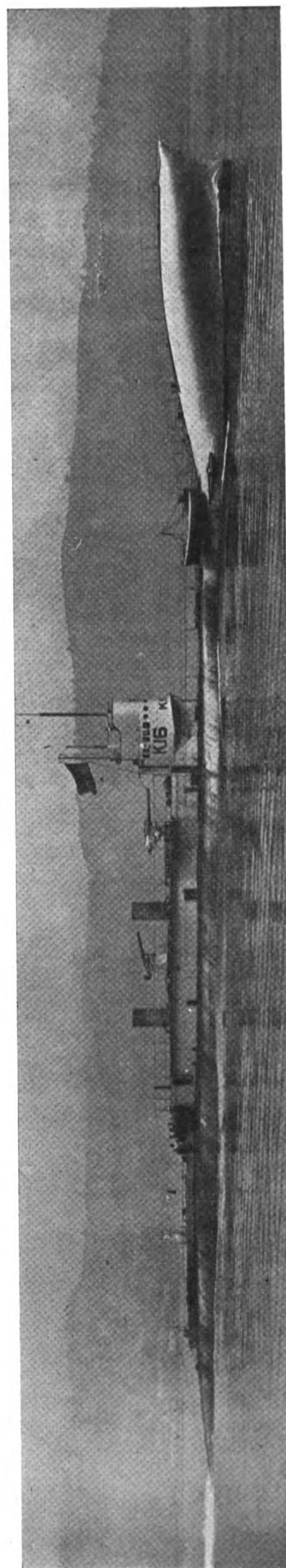
Installation D—Three 1000 H.P. engines.
Corresponding speed 21.2 knots.

	Coal-Fired Steamship	Oil-Fired Steamship	Motorship
Total shaft horsepower.....	3000	3000	3000
Normal fuel-capacity	30 tons	8000 gals.	8000 gals.
Radius of action at full speed.....	210 miles	320 miles	800 miles
Fuel-consumption per hour at full speed.....	3 tons	530 gals.	212 gals.
Fuel-consumption per mile at full speed.....	320 lbs.	25 gals.	10 gals.
Radius of action at 12 knots speed.....	640 miles	960 miles	2400 miles
Fuel-consumption per hour at 12 knots speed....	1260 lbs.	100 gals.	40 gals.
Fuel-consumption per mile at 12 knots speed....	105 lbs.	8.3 gals.	3.3 gals.
Engineer force—engineers	4	4	6
—water tenders	3	3	0
—oilers	3	3	3
—wipers	0	3	3
—firemen	9	3	0
—coal passers	6	0	0
Total	25	16	12

Plans for three types of vessel have been made, of which two are reproduced herewith. Passenger vessel No. 1, passenger vessel No. 2, the third being a yacht. Passenger vessels No. 1 and No. 2 differ in that the former is intended for a night run and provides for a maximum of staterooms, while the latter is intended for a day run, and provides for larger cabins, smoking-room and dining-rooms, with a moderate number of staterooms. The general arrangement is similar in the two cases. A deck-house is added to the vessels, in which are state-rooms forward, smoking-room and main-saloon, Purser's, Steward's and Chief Engineer's quarters and toilets. In the day boat there is an after cabin, which is replaced by state-rooms in the night boat. The crew's quarters are forward in the present forecastle. A

fuel-oil tanks. The existing engine-room is used for both main engines and donkey-boiler. Any one of the engine installations mentioned above, and certain intermediate powers as well, can be used. The number of passengers that can be accommodated in state-rooms is as follows: Passenger vessel No. 1, 94; passenger vessel No. 2, 46.

For a yacht the hulls adapt themselves extremely well, the fine lines lending themselves to a speedy and graceful vessel with but moderate powers. While the internal arrangement of a yacht is a matter depending very largely on the personal idiosyncrasies of the owner, the plan as laid out shows the very commodious quarters that can be installed. But, as "Motorship" does not deal with pleasure craft, we are not describing her.

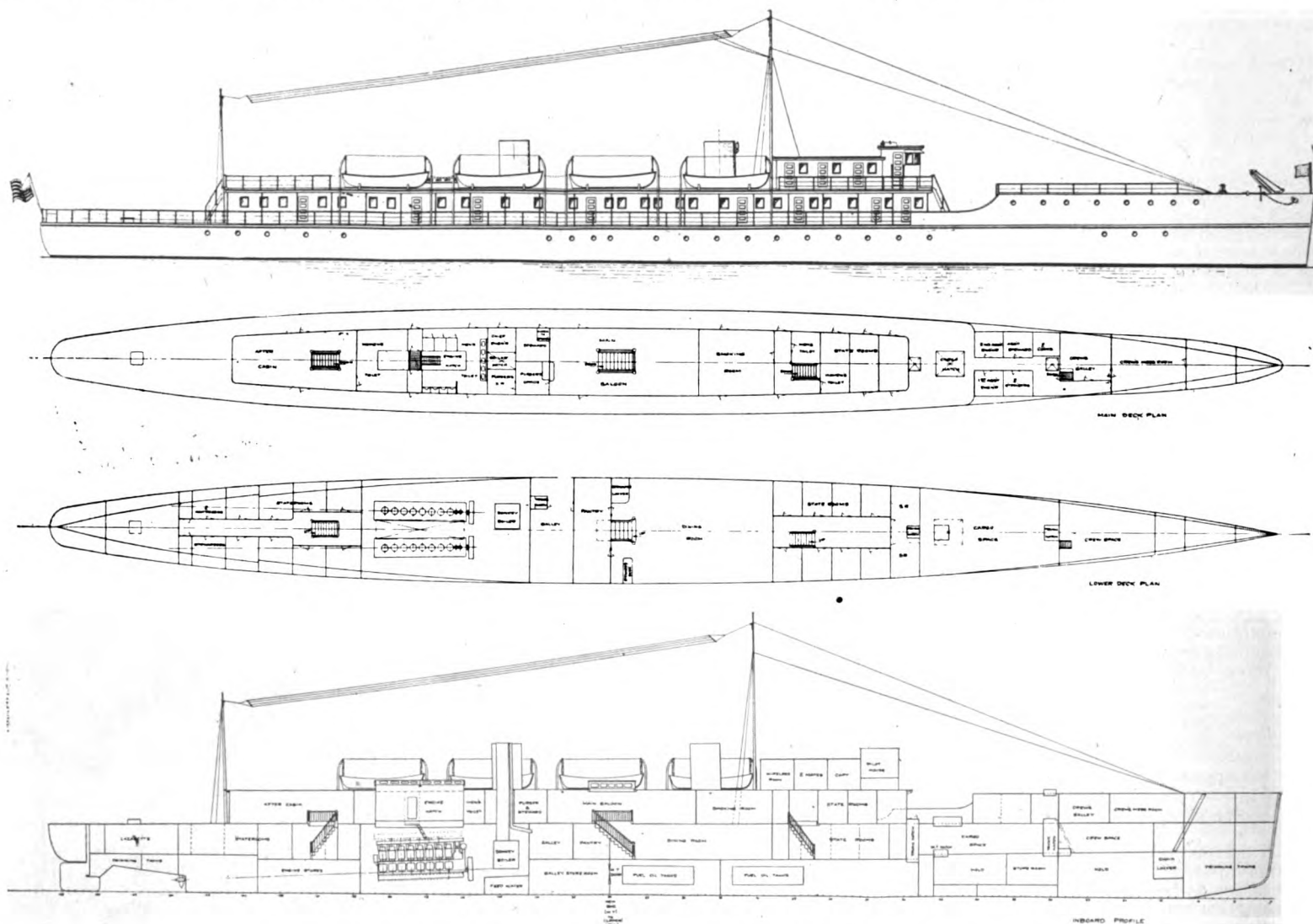


The U. S. Naval Board have just recommended that two 2,000 ton submarines shall be built. The above is a striking illustration of one of the British Navy's 10,000 horse-power submersible-cruisers. She is of 2,650 tons submerged-displacement, of 24 knots speed, and was built by Wm. Beardmore & Co. For cruising she has an 800 h.p. Diesel-electric drive.

On the whole, these vessels are an interesting example of the adaptability of the Diesel-engine to varying conditions of service, and show clearly its superior economy both in operation and in

space occupied. A steam installation would require so much additional space as to reduce the carrying power of the passenger vessels below a paying basis, and would very materially reduce

the accommodations in the yacht, while nothing like the radius of action enjoyed by the Diesel-installation would be possible with any reasonable fuel-supply.



Converted destroyer No. 2 showing accommodation and machinery arrangements.



One of the U. S. Navy's 110 ft. Standard-engined patrol-boats in choppy water.

Comparison Between Marine Diesel-Engines of the Two and Four Cycle Types

Extracts from Paper Read by Director Blache of Burmeister & Wain Before the Norwegian Veritas

(Translated by Our Danish Correspondent)

WHEN the manufacture of Diesel engines for large ocean-going vessels was taken up in the years 1910-1911 by several large engineering works, such as Augsburg, Nuremberg, Krupp, Werkspoor, Sulzer, Carels, Burmeister & Wain and others, the most curious incident was that, with the exception of Werkspoor and Burmeister & Wain, all the engine-works started at the same time to build two-cycle motors, which at that period were not well adapted for stationary work. I have often wondered what was the real reason of this, and have come to the likely conclusion that designers in small countries, like Scandinavia, Holland and Denmark, were by their more restricted working-conditions forced to deal with varying tasks, requiring a more universal training, while in large countries the tendency was to turn into specialists by confining themselves to a single task. Thus, when the building of marine Diesel-motors was taken up in other circles the specialist designers of the Diesel engine-works, lacking the

the Werkspoor engine following next as an easy second, the step being large when passing again to ships with two-cycle motors, where those equipped with Carels engines will be noted. This Diesel motor is of the single-acting two-cycle type, being made by various yards that required a license of manufacturing rights.

Krupp in Kiel also built a single-acting two-cycle engine, mainly like that of Carels, with which the motor tankers "Hagen," "Loki" and "W. A. Riedemann" were powered, the latter not being completed before the outbreak of the war. The "Hagen" made some voyages before the war, but it is generally known that her engines did not work satisfactorily, the vessel being held-up in Hamburg for repairs. When the war broke-out the "Hagen" was in New York, where she was taken over and put in service by Standard Oil Co. and named "Glenpool." The Americans soon found it impossible to run the motors satisfactorily, wherefore they were removed, and the Standard Oil Co. inquired of Burmeister & Wain whether they could have engines of their make installed. But the plan was dropped, as the necessary time for the change was too long. So ordinary marine steam-engines were installed. The sister vessel "Loki" carried out one voyage, lying at the outbreak of the war in Hamburg, where she was retained. So far as my knowledge goes, the "W. A. Riedemann" has not yet been put in service.

As mentioned already, the Krupp, Nurnburg and Carels motors have features of similar design, the cylinder heads being perforated too much by the employment of fuel, starting and scavenge-valves. It has been proved in practice that such a design is unable to stand the great heat stress to which two-cycle motors are subjected. There is combustion at each revolution, and thus it is safe to state that this type of two-cycle marine Diesel-motors have proved useless. A further cause for the arising of difficulties was that they were built as open engines with ordinary drip lubrication. The reason why lubrication is very difficult is that the pressure does not vary at all. During the down and up-going stroke the ignition pressure and the compression press the piston down hard; and at the bottom dead-center, where there is no pressure in the cylinder itself, there remains a

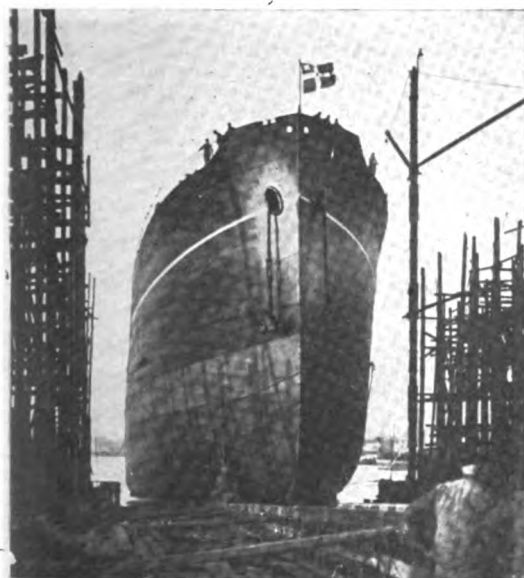
our motors force-fed oil is pumped through the bearings in large quantities, so the lubricating-oil can then fully absorb the arising backlash, and the gudgeon rests on a thick film of oil.

Another difficult circumstance of the two-cycle motor is the long piston required to keep the exhaust-port closed. If the crosshead brasses after long service are worn slightly different, the long piston will get an inclined position and a scoring is the result. But with four-cycle motors the piston can be made very short; in fact, no longer than required for the necessary number of piston-rings, and the effect is that the piston can be somewhat inclined without any scoring resulting. This point is a matter of experience, as we ourselves built our first engines with long pistons and had to shorten them. Altogether the piston is a very important part in the motor, and so it is fundamentally wrong to employ it as exhaust-valve, which really takes place in the two-cycle motor. You will see that it continually passes the opening in the cylinder surface, and is surrounded by the hot exhaust-gas from the other cylinder.

The piston-rings in the four-cycle engine rub against an uninterrupted even cylinder wall where they can distribute the lubricating-oil in a film over the whole cylinder surface. In the two-cycle motors the lubricating-oil is scraped off in the exhaust channels. Consequently the cylinder-oil consumption of this type of engine is always very high, as a very liberal lubrication is required, the greater part of the oil being lost in the way explained.

After the unsuccessful double-acting motor referred to, Blohm & Voss and Nurnburg built a single-acting two-cycle motor for the Hamburg-American Line's vessel "Secundus," which made one voyage before the war. At a U. S. naval yard a pair of large two-cycle motors for the tanker "Maumee" were built, but very little information is available regarding the practical service performance of these two vessels. It is, however, my personal belief that all Diesel motors with scavenge-valves in the covers will prove unsatisfactory.

Furthermore, in my opinion, the best two-cycle Diesel engine is that built by the firm of Sulzer



Launch of the World's largest motorship in Denmark.

knowledge of marine engine requirements, sought the co-operation of the specialist-designers of marine steam-engines. The latter had again no proper knowledge of the Diesel motor, and were incapable of imagining that a marine Diesel-motor could be employed. Consequently the result was an engine as near to marine steam-engine design as possible.

At this period the general opinion thus was that marine Diesel-motors must be of the two-cycle type, and preferably of the double-acting type, and we, who stuck to the four-cycle model, were considered to be inferior engineers. Having left the Augsburg-Nurnburg Co. and working on his own account, Dr. Diesel also advocated the two-cycle motor, and worked hard to develop the same.

So, the first large marine Diesel-motor for a sea-going vessel was made as a double-acting two-cycle engine. It was built by Blohm and Voss and erected for testing in their workshops in Hamburg. As a double-acting two-cycle motor it developed work in each stroke, both during the up and down-going movement of the piston, i. e., just like the ordinary steam-engine. It, however, turned out to be impossible to get the motor working satisfactorily, and after long experiments it was condemned, never attaining erection in a vessel.* Meanwhile the four-cycle motors for "Selandia" were completed, and thus this ship became the first large sea-going motorship.

[Here Mr. Blache gives a list of motorships of 500 h.p. and over, in service, but as this list is not complete, none of the latest Ansaldo San Giorgio, McIntosh & Seymour or the old Russian ships being included, we are not publishing it, but are giving the B. & W. ships only.—Editor.]

Fifty-three of the sea-going motorships in this list are equipped with Burmeister & Wain motors,



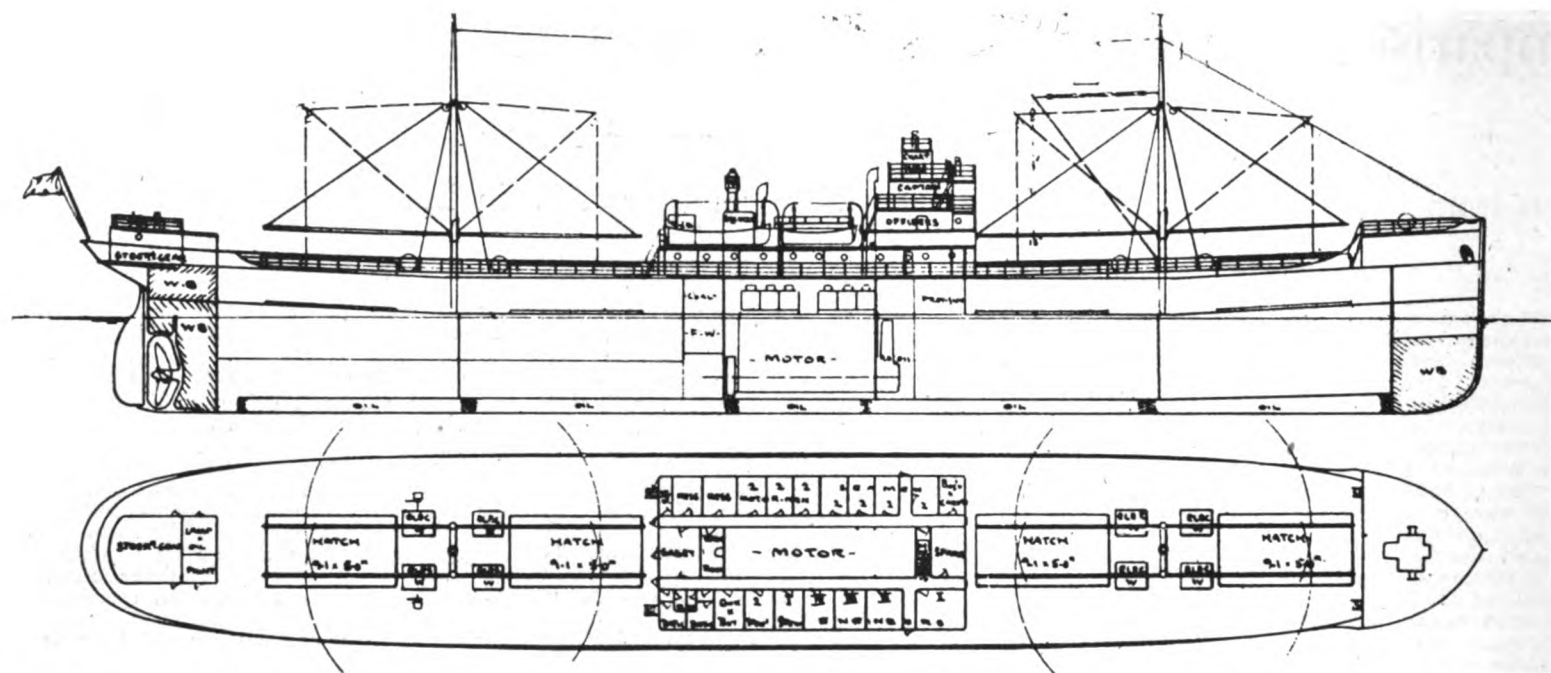
• The passenger and cargo motor-ship "Fionia." On one long voyage she made 39,366 nautical-miles in 10 months. Her accommodation is very luxurious.

considerable downward pressure on all bearings.

This, however, is not the case with the four-cycle motor. Here the exhaust is ejected through the exhaust-valves in the cover. When the piston passes its top deadpoint the exhaust-valve closes and the inlet-valve opens so that the cylinder is filled with fresh air during the down stroke. At this moment there is no pressure in the cylinder, and the piston and the connected-rods are stopped in their upward movement and again have a downward movement initiated. The effect is a strong upward pull of the rods, with the result that the latter and the crank-shaft are lifted upwards. With

*The Blohm & Voss double-acting two-cycle Diesel engines were installed in the motorship "Fritz", now in service of the Glen Line of Liverpool & London.—Editor.

Bros. in Wintherthur, Switzerland, and several other firms have followed with similar designs. Sulzer built these engines for the motorship "Sabara" ex "Monte Penedo," that was constructed at the Howaldts yard, Kiel, Germany, and put in service in 1912, some time after "Selandia." The engines are built without scavenge-valves, whereby the covers have greater strength and can thus better stand the severe heating without cracking. Scavenging is effected through ports in the cylinder-wall, somewhat above the exhaust-ports. These scavenge-ports are equipped with slide, or ordinary valves of rather large dimensions. This form of scavenging is not as effective as scavenge-valves in the cover, but as the scavenge-air is controlled by valves, and not alone by the piston, it is possible to pump additional pure air into the cylinders un-



A single-screw motorship of 4,500 tons d.w.c. and 1,400 i.h.p. being built by Delaunay Belleville, of France, from designs by Burmeister & Wain. See page 219 of our March issue.

der somewhat higher pressure, whereby, in spite of the bad scavenging, sufficient air is obtained to feed the combustion during the following stroke, even though the air is somewhat polluted by the preceding charge of exhaust products. At the same time the motors become very complicated, as this fairly large-dimensioned valve system, mounted below on the cylinder, has to have a special control, and, further, the mechanical efficiency of the motor drops to about 60% or lower, as operated by the engine itself the scavenge-pump has to pump the air to the higher pressure.

The "Monte Penedo" has been in service since 1912 and has made several long voyages without stoppages. So far as I know, further ships with Sulzer motors have not been built till lately, including by the Italian firm of Ansaldo-San Giorgio, Ltd. The name of their first vessel is "Ansaldo San Giorgio, I."

I have pointed out the various special technical difficulties experienced in the manufacture of two-cycle motors, so that it is considerably more difficult to design a two-cycle motor giving satisfactory results than a four-cycle motor. The condition remains, however, that it be possible to tackle fully these technical difficulties. According to the general opinion, the gain should then be that the same motor carried out the double amount of work. This, however, is not the case. It has been proved that the two-cycle motor does not give twice the horse-power of the four-cycle motor of same cylinder dimensions, i. e., the same cylinder diameter, bore, stroke and number of r.p.m. This I personally have had a chance of seeing proven in the manufacture of some Diesel motors for submarines to the Danish navy.

Before the war the Danish navy built their own submarines and adopted two-cycle motors for them. Early in the war two craft were completed, but the engines, owing to the war, were not to be had. We then received an inquiry whether we could build motors of the same b.h.p. output at the same number of r.p.m., same weight and dimensions of the engine. Its length, beam and height were not to surpass the corresponding dimensions of the two-cycle motors, as the available space in such a small submarine for the shallow Danish waters was so limited that an increase of the dimensions was impossible.

Having gone through the matter I found that these conditions could easily be fulfilled by the four-cycle motor, and we built the four-cycle engines, fitting the space. In fact, they were even considerably smaller than the corresponding two-cycle motors. Whereas the latter weighed 10½ tons, the complete weight of the four-cycle motor was 9 tons; 1½ tons had thus been saved in weight, enabling a corresponding increase of the fuel-bunker space of the craft and, incidentally, her range of action.

Another result was that while the fuel-consumption of the two-cycle motor was 234 grams, the corresponding figure of the Burmeister & Wain four-cycle motor worked out at 192 grams. In other words, the fuel-consumption of the two-cycle motor per b.h.p. hour was 22% higher than that of the four-cycle motor. In the tests carried-out in our testing-shop it was further seen that the cylinder dimensions chosen by us were ample, as the motor easily developed 500 b.h.p. instead of the stipulated 450 b.h.p. The cylinder figures of the four-cycle motor were: 330 mm bore and 290 mm stroke, and those of the two-cycle motors 270 mm bore and 290 mm stroke. The ratio between piston area, multiplied by stroke in these two different engine types works out thusly at: 1.7, or, in other words, for the same cylinder dimensions the two-cycle motor has only a 70% higher performance, and thus not double that of the four-cycle motor. As I already mentioned, the dimensions of the four-cycle motor had an easy margin, so that when the performance of which the four-cycle motor is really capable, is considered, the ratio works only out at 60%, and this may be considered to be the general figure. This applies only to the dimensions of the cylinders, not to those of the motor itself, for the fact is that the work procedure to be carried out is the same in both engine types.

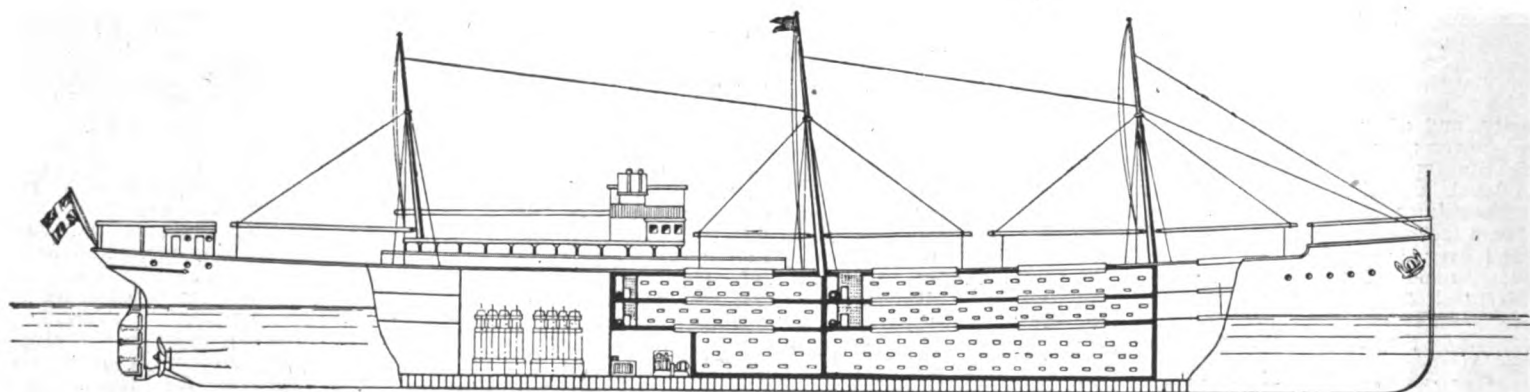
As I have thus demonstrated to you, we shall always be able to build a four-cycle Diesel motor of the same overall dimensions as the corresponding two-cycle engine of equal h.p. and r.p.m., the reason being that one cannot avoid the process of removing the exhaust products from the cylinder and replacing them by fresh air, and that the space required by the machinery remains the same, whether one does it by means of an extension of the Diesel-motor piston itself or by means of special

pump. Thus nothing is gained with regard to saving space by employing the two-cycle system.

But then must be added the huge drawback of the two-cycle motor, constituted by the development of 60% more power in the same cylinder, as this fact means that on the same cylinder surfaces, on the bottom surface of the cover, and on the top of the piston, 60% more fuel is burned in the same time as in the four-cycle motor. What stress the single parts of a motor can bear and what sets the limit to its performance is just what amount of strain one ventures to expose these parts to, or, in other words, how big a quantity of oil can be burned. Here the relation is similar to a steam-boiler. The latter is strained in relation to the amount of coal burned in the boilers per sq. me. heating surface. An over-forcing is disastrous to the boiler, and the same applies to the motor. We are in the marine Diesel motors far from consuming the amount of fuel that could really be burned.

The four-cycle motors of Burmeister & Wain are built to a mean-pressure of 6.2 Kg. for normal loading at sea, while we employ for our stationary engines a mean-pressure of 7.2 kg. for normal load, and could easily force the mean-pressure up to 8.5 kg. Thus our marine motors could without any difficulties develop 35% more power than their normal performance. We keep, however, this mean pressure—and thus the amount of fuel consumed in the motor in relation to the size—very low to be able to carry out the long non-stop voyages required of the ships built by us. Thus motorships built by us for the North Star Shipping Co. of Stockholm have carried out voyages from Scandinavia, rounding Cape Horn to San Francisco without any stop en route, which means an uninterrupted working of the motors for 62 days.

Another point of advantage also to the four-cycle motors is their lower fuel-consumption, by 15 to 20% per b.h.p. hour compared with the two-cycle engines. The foremost importance of this saving in fuel lies in the fact that just this burning of oil, which is not turned into useful work, has a special detrimental effect on the engine, as the whole amount of this energy goes to heat the engine parts without doing any useful work. From this you will see the reason why Burmeister & Wain adopted and still adhere exclusively to the manufacture of four-cycle motors.



Section of Danish motorship equipped with refrigerator installation for the transportation of fruit.

In "Motorship" for April, 1918, the motors being built by Ansaldo San Giorgio are further referred to, of which the first has been completed, as I have stated above. Here the fuel consumption is given at $10\frac{1}{2}$ tons for 24 hours at a speed of 11 knots, which corresponds to 0.45 lb. or 205 grams per hour, which is 14% higher than by the four-cycle motor. The consumption of lubrication-oil is given at 0.017 lb. or 7.75 grams per b.h.p. hour.

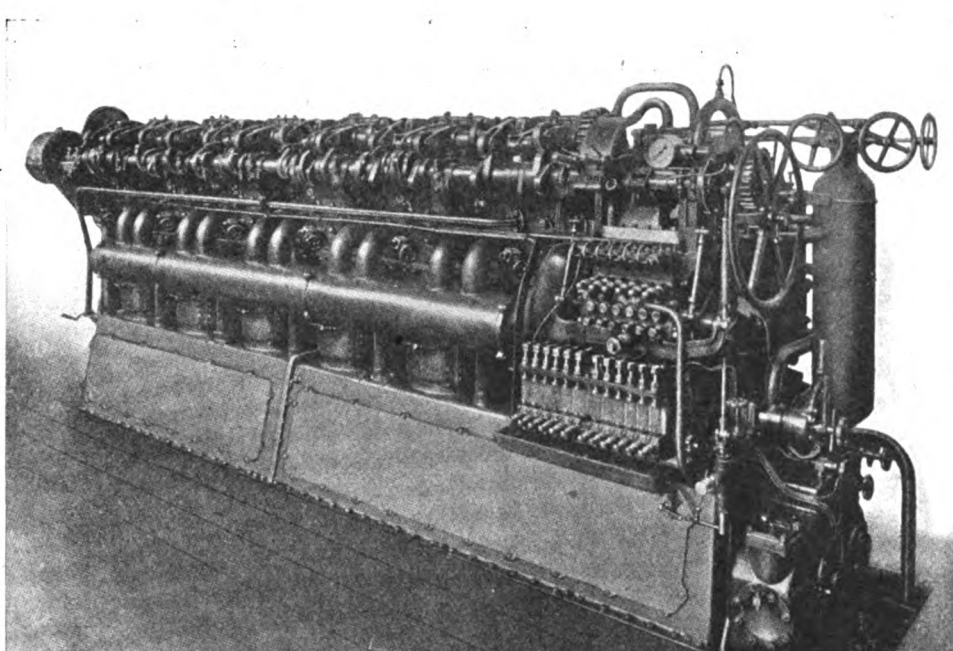
To afford a comparison I give the figures of some quite ordinary voyages made by two of the motorships of the East Asiatic Co., from which you will find that the Burmeister & Wain four-cycle motors have only $\frac{1}{9}$ the lubrication-oil consumption of that stated for the two-cycle motor, and it can generally be said that the consumption of lubrication-oil is 9 times higher in the two-cycle than in the four-cycle motor. This latter lubrication-oil consumption represents from 3 to 4 tons on a voyage of 6 to 8 months' duration, which, multiplied with 9, works out at 27 to 36 tons, being a considerable figure.

Burmeister & Wain were the first firm to adopt electric auxiliaries, and this has materially contributed to the reliability and economy of these motorships. Electricity has in stationary work ultimately superseded every other form for power transmission on account of its big advantages in service; as the motors, cables and instruments are now so excellently made, a high reliability is attained. This form of transmission is therefore bound to be adopted in the end on board Diesel vessels, also those of steam. The advantage especially applies to Diesel motorships, where the electric current can be produced by Diesel-dynamo aggregates and even in steamers electric-driven auxiliaries often are adopted.

During a visit to the Pusey & Jones yard in Philadelphia, U. S. A., I saw a 13,000 tons d.w.c. steamer being built to be equipped with electric winches, windlass and steering apparatus. This arrangement is adopted in steamers to reduce the huge steam consumption that results from the uneconomically operated winches, steering mechanism and pumps, and not least, to save the enormous losses always escaping through the long steam pipes which lead from one end to the other in a steamer. Considerably more, however, is saved by the employment of electric-driven auxiliaries in Diesel motorships than in steamers, as much less quantities of fuel are required for the production of the electric current to drive the auxiliary machinery in the Diesel-dynamo aggregates than in small steam engines or turbines.

At the request of the owners the first motorship—the "California"—we built for the United Shipping Co. of Copenhagen, was equipped with steam winches, but their next motorship—the "Oregon"—of the same size was equipped with electric winches, again at the request of the owners from the experiences that they had gained with the steam-winches on the "California." The result attained by loading and unloading of these 2 vessels with all winches operating and thus loading nitre in America was as follows:

The "California" in port consumes, with all steam-winches engaged, 2,960 kilos of fuel in 24 hours, against a consumption of 422 kilos of fuel on the "Oregon" with all electric winches employed in 24 hours. Or, in other words, the steam-winches consume 7 times as much fuel as the electric-driven winches. Yet it must be added



Burmeister & Wain submarine Diesel engine developing 450 b.h.p. at 500 R.P.M. Seven of these motors were built.

that the "California" employs steam only for the service of the winches, while all the rest of the auxiliary machinery is electric-driven from the Diesel motor plant, so that the service is considerably more economical than if the auxiliary machinery had also been steam-driven, in which case the relation should no doubt have worked out at 10 times more fuel-consumption than by a ship with electric-driven auxiliary machinery.

When the Burmeister & Wain motorships were built as twin-screwed ships, the general belief had been that the reason was a consideration of reliability. There is, of course, an advantage by having two motors in a vessel, enabling it to reach harbor on one engine if the other breaks down. This justifies a smaller insurance premium for twin-screwed vessels than for single-screwed craft. But it would be impossible to employ motorships if the Diesel motors were really so unreliable as to require the presence of twin engines, for the ship represents such a large capital outlay and the expenses of maintaining it at sea with crew are so high that the service would be much too costly if the speed was often reduced owing to the one motor being out of service. So it was not considerations of reliability that led us to employ the twin-screw arrangement, but the object was to attain the same good propeller-efficiency at higher revolutions.

This specially applies to large horse-powers, where it is necessary to continuously reduce the number of r.p.m. to maintain the same good propeller-efficiency as by power-transmission through one propeller. Thus it is advantageous to have twin propellers, as a quite as good or even improved propeller efficiency as that generally attained by single-screw drive is attained with twin

propellers of a number of r.p.m. between 115 and 150. In small vessels it is, however, unfavorable to have two shaft-tunnels as they occupy too much useful space in the stern hold. Consequently I have developed a new type of Diesel motors for single-screw ships, built with a specially long stroke, so that the number of revolutions can be kept as low as 75 down to 5 per minute.

Burmeister & Wain have designed an engine for Delaunay Belleville of St. Denis sur Seine, who held the license rights for manufacturing the Burmeister & Wain Diesel motor in France and her colonies. Delaunay Belleville has constructed a yard at la Rochelle for building motorships, and has started building standardized vessels of 4500 tons d.w.c. Such a ship is capable of carrying fuel for a distance of 30,000 miles, and in the management of a practical shipowner can be turned to a much better account than a corresponding steamer.

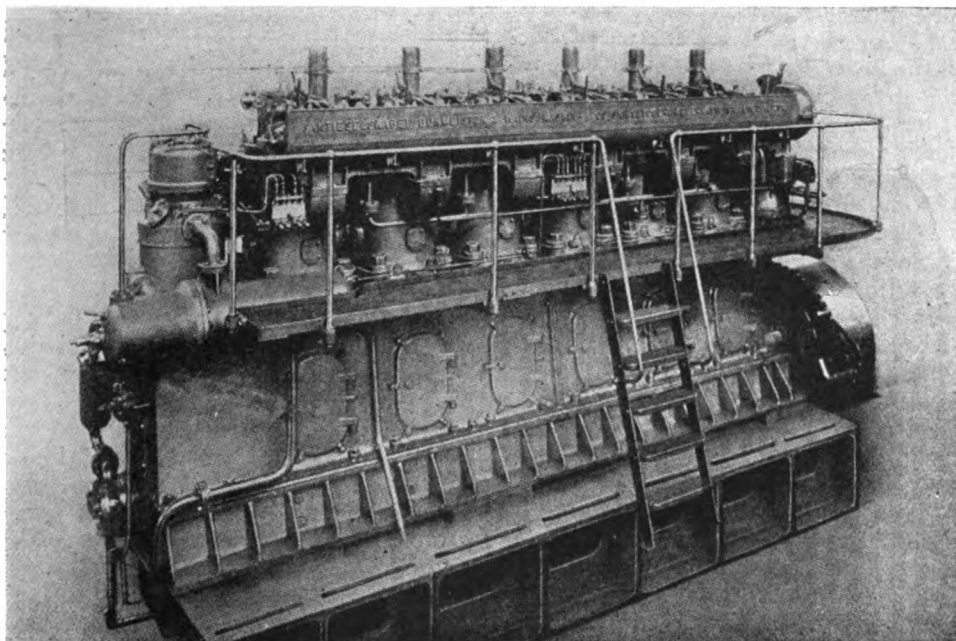
We also have produced marine Diesel-motor of the trunk-piston type, built with long stroke and corresponding low number of r.p.m., viz., 140 to 150 per minute for employment in small motorships. The engine in question is destined for a vessel now being built at Nes Mechanical Works in Tönsberg for Consul Blikstad.

During a recent journey to America I visited various large American shipping companies, and found that they knew our motorships well, as they have been chartered to them during the war. Their inspectors have gone through these Diesel-driven vessels and have reported upon their consumption. The curious point was now that these men stated the consumption to be $\frac{1}{5}$ th of the figure for their corresponding steamers with oil-fired boilers. As the consumption of their steamers is so high in relation to the consumption of the Burmeister & Wain motorships, the reason must be specially bad attendance and uneconomical steam-engines. Also, partly owing to the loss of considerable quantities of fuel by uneconomical feeding, bad attendance and firing and due to the large consumption during loading and unloading in harbor.

But even with excellent attendance and the most economical steam machinery, I am certain that the real practical figures of result in oil-fired turbine-vessels with all modern equipment shall work out 300% higher than for the corresponding Diesel motors. So, gentlemen, if coal must be employed for the propulsion of your ships, use geared-turbines; but if oil-fuel, use Diesel motors. The latter is the future marine power, and the four-cycle engine will be the marine motor of the future.

SEVEN GERMAN MOTORSHIPS TAKEN OVER BY THE ALLIES

Under the armistice terms the following seven large steel ocean-going motorships were taken over by the allies, namely: "Wotan," "Sabara," "Wm. Riedermann," "Loki," "Secundus," "Fritz" and "Christian X." It is possible that the Standard Oil Co. may get the "Wotan," as she and two other of the above ships were owned by their German subsidiary company. But surely America should have received at least one of the other Diesel vessels mentioned? If not, why not?



A 380-400 h.p. trunk-piston type Burmeister & Wain Marine Diesel engine.

Sulzer Two-Cycle Engines and the Propulsion of Cargo Boats

Comparison with Four-Cycle Diesel Engines, Steam-Reciprocating Engines and Steam-Turbines

(Specially Prepared by Sulzer Brothers)

PART II

(Continued from page 212 of the March issue)

The results of an examination into this question are given in the curves in figure 9. The ship chosen is a cargo ship of 12,500 tons loaded-displacement and 12 knots speed. With an efficient propeller such a boat requires engines of about 3,200 shaft H.P. Besides single-screw and twin-screw boats propelled by four-cycle and two-cycle engines, also single-screw and twin-screw ships propelled by steam reciprocating-engines, and a single-screw ship propelled by steam-turbines, have been considered for comparison. In fig. 9 the amount of net-tonnage available for freight for each method of propulsion considered, has been plotted as a function of a radius of action of 0 to 80 days. From this diagram it can be clearly seen that the net tonnage of steam-engined ships, on account of the large quantity of coal required, falls off rapidly as the radius of action is increased. In the case of the single-screw ship for a radius of action of 30 days there is an available net-tonnage of 6,500; but when the radius of action is increased to 80 days, only 4,400 tons net is available. Here, therefore, only about one-third of the displacement is available for freight and the dead-weight which has to be conveyed amounts to over 8,000 tons. When the single-screw ship is propelled by steam-turbines the values are somewhat better.

In order that a proper comparison may at once be made between these various conditions of working, a system of dotted lines has been added to fig. 9. These dotted lines show the percentage difference in the cargo carrying-capacity of the various methods of propulsion, as compared with that of a steam-engined single-screw ship. The 100% line therefore corresponds exactly to the carrying capacity curve for such a ship for the different radii of action. Referring to these dotted lines, the cargo carrying capacities of the variously propelled ships may at once be estimated and compared.

An examination of the various curves shows the following. When the radius of action is very small, only the cargo carrying-capacity of a turbine-steamer, and still more particularly of a two-cycle motorship, is superior to that of a single-screw steam-engined ship. The difference in the former case is about 3%, and in the latter about 5%. Four-cycle engines on the other hand in ships with the propeller-speed usual in ordinary steamers show no advantage over these latter in cargo carrying-capacity. In this respect, twin-screw steamers are always somewhat worse than single-screw.

If a greater radius of action is called for, the advantages of the motorship on account of its low fuel-consumption, become more and more apparent the greater the radius of action demanded. For example, a single-screw ship of the type under consideration, propelled by a two-cycle engine, shows a great increase in cargo carrying-capacity, in comparison with a similar single-screw steamer. It is:

13% for a radius of action of 15 days,

22% for a radius of action of 30 days,
36.5% for a radius of action of 50 days,
and 63.5% for a radius of action of 80 days.

In two-cycle motorships with twin-screws these figures are only slightly less, the difference varying from 0 to 2%. In the case of four-cycle engines, the gain in net-tonnage over the steam vessel is about 6 to 11% less than the corresponding figures for the two-cycle engine cited above. There is therefore quite a large difference here between two-cycle and four-cycle motorships; and the advantage lies with the two-cycle ship, in spite of its slightly greater fuel-consumption. It is accounted for particularly by the machinery being much lighter and taking up less space. Turbine-driven steamers have more cargo carrying-capacity than ships with reciprocating steam-engines, 3 to 13% according to the radius of action. That is, of course, presuming that the assumed saving

can be taken on board and the whole of the available tonnage of the ship cannot be utilized. The drawback of such cargoes is most apparent when the nature of the goods demands that they be stowed below.

In figures 10-17, the cargo-boat of 12,500 tons displacement which we have chosen as example above, is shown as a whole. In each of the different figures, a different means of propulsion is assumed. The engine-room and the propeller-shaft tunnel can be clearly distinguished; the space taken up by fuel, for 50 days working, plus an emergency reserve for 5 days, is shown by shading, thus distinguishing it from the space available for cargo. Figs. 10-13 are single-screw boats, driven by steam reciprocating-engines, steam-turbines, four-cycle and two-cycle engines respectively. Figs. 14-17 show the same ship fitted with two propellers. As

Fig. 7.—3200 B.H.P. Four-Cycle Diesel-Engine and Auxiliaries for Single-Screw Cargo-Boat

Main Engine: 8 Working-Cylinders. Cylinder Bore 35 ins. (890 mm.);
Stroke 56 ins. (1420 mm.); Speed 85 r.p.m.

Machinery	B.H.P.	Tons	Weight In per cent of similar 2-cycle installation.
Main Engine Complete.....	3200	869	207%
Auxiliary Power-Plant.....	3x100	45	64%
Piping, Floor-plates, Gangways, Handrails and Gratings in Engine Room and Funnel. Electric and other Auxiliary Installations; Water and Oil in the Engines and Piping. Equipment according to Inventory.....		80	138%
Piping outside the Engine Room.....		113	123%
Shafting and Propellers.....		50	100%
		106	125%
Total Machinery.....	3500	1263	163%
Space required, 1332 Reg. Tons=3773 cb. m.=130% of that for corresponding two-cycle installation.			

Fig. 8.—Two-Cycle Sulzer Diesel-Engine (of the same Power as the Engine in Fig. 7) for Single-Screw Cargo-Boat

Main Engine: 6 Working-Cylinders. Cylinder bore 29¾ ins. (760 mm.);
Stroke 47¼ ins. (1200 mm.); Speed 85 r.p.m.

Machinery	B.H.P.	Tons	Weight In per cent of similar 4-cycle installation.
Main Engine Complete.....	3200	420	48.5%
Auxiliary Power-Plant.....	2x410	70	155%
Piping, Floor-plates, Gangways, Handrails and Gratings in Engine Room and Funnel. Electric and other Auxiliary Installations; Water and Oil in the Engines and Piping. Equipment according to Inventory.....		58	72.5%
Piping outside the Engine Room.....		92	81%
Shafting and Propellers.....		50	100%
		85	80%
Total Machinery.....	4020	775	61%
Space required, 1023 Reg. Tons=2897 cb. m.=77% of that for corresponding four-cycle installation.			

of coal, as compared with ordinary engines—about 10%—is actually arrived at. If that is the case, the steam-turbine is capable of competing with the reciprocating steam-engine if the cost of installing it is reasonable.

Besides the cargo carrying-capacity as regards weight, the so-called available tonnage, it is also important to know what space is available. If the holds are large, more cargo of low specific gravity can be stowed in them. If, on the contrary, they are small, it can often happen that only small cargoes

twin-screw cargo-boats propelled by steam-engines are comparatively rare, generally only motorships being so fitted, these four figures are all for motorships.

In the ships in Figs. 14 and 15 both the four and the two-cycle engines have been chosen for a speed of 85 r.p.m., corresponding to the usual practice with steam-engines. Figs. 16 and 17 show high-speed Diesel-engines, running at 130 r.p.m. But in this case, as the efficiency of the propeller is decidedly less on account of its higher speed, the B.H.P. required is 3,500 instead of 3,200

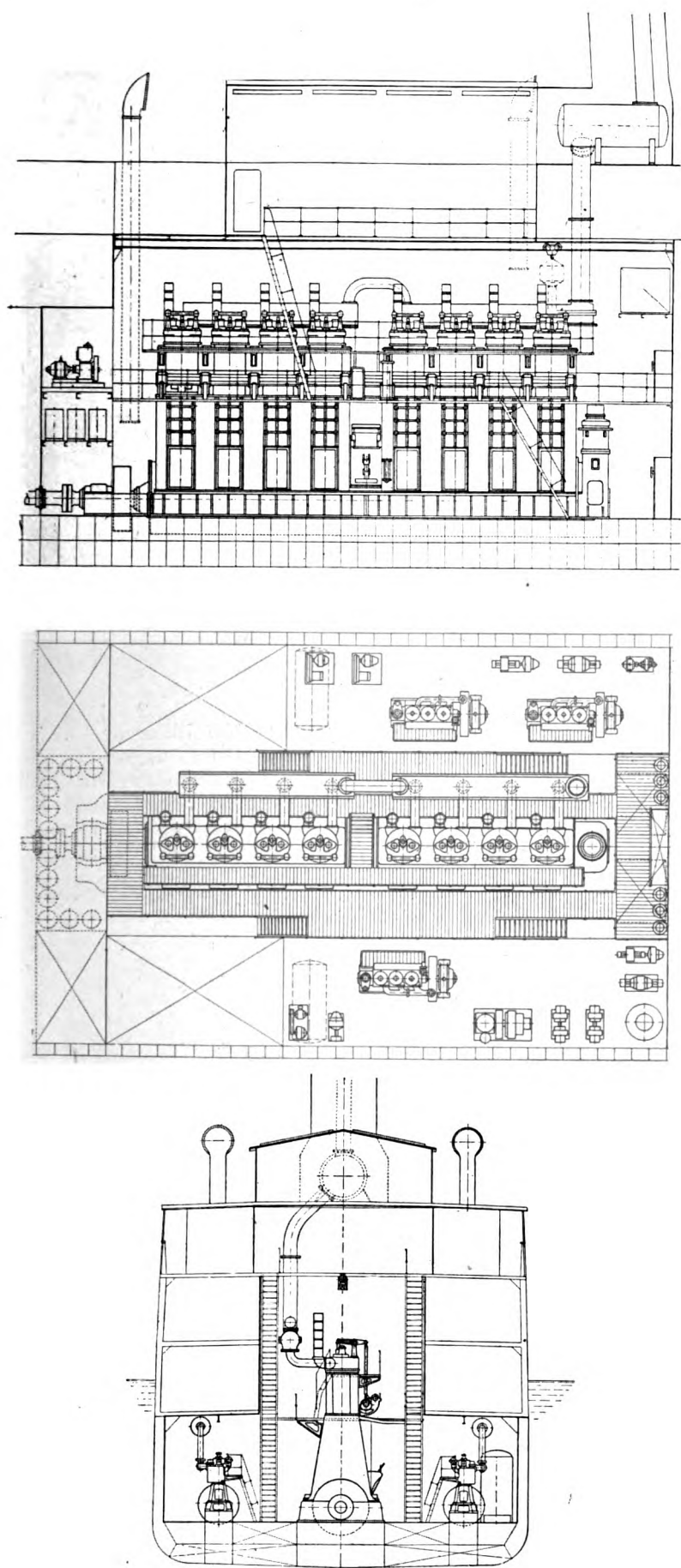


Fig. 7. Single-screw four-cycle installation of 3200 b.h.p. for comparison with Fig. 8.

as in the case of the slower running engine.

A glance at these figures at once shows the principal differences between these systems of propulsion. One feature of the steamers which at once strikes the eye is the great space requisite for the coal bunkers, a little less for the steam-turbine than for the reciprocating-engine. If crude-oil were used for firing the boilers—as is done in many cases—space would indeed be saved and made available for cargo, but the cost of running would be much heavier, as in some countries this fuel is much dearer than coal. Such fuel can therefore be used for

calories (16,800 to 24,000 B.Th.U.) in the boiler-firing only in very exceptional cases. Where crude-oil is cheap, it is all the more advisable to change over to Diesel-engines, as with them, even compared with the best steam-turbines, 2.2 to 3 times less oil would be consumed for the same work done.

Crude-oil can be easily transferred here and there in the ship by means of suitable piping, and it is therefore possible to store it wherever is most convenient. Part of the oil can be kept in the double bottom, thus freeing further room for cargo. A ton of crude-oil requires about 1.05 to 1.2 m³ (37.1

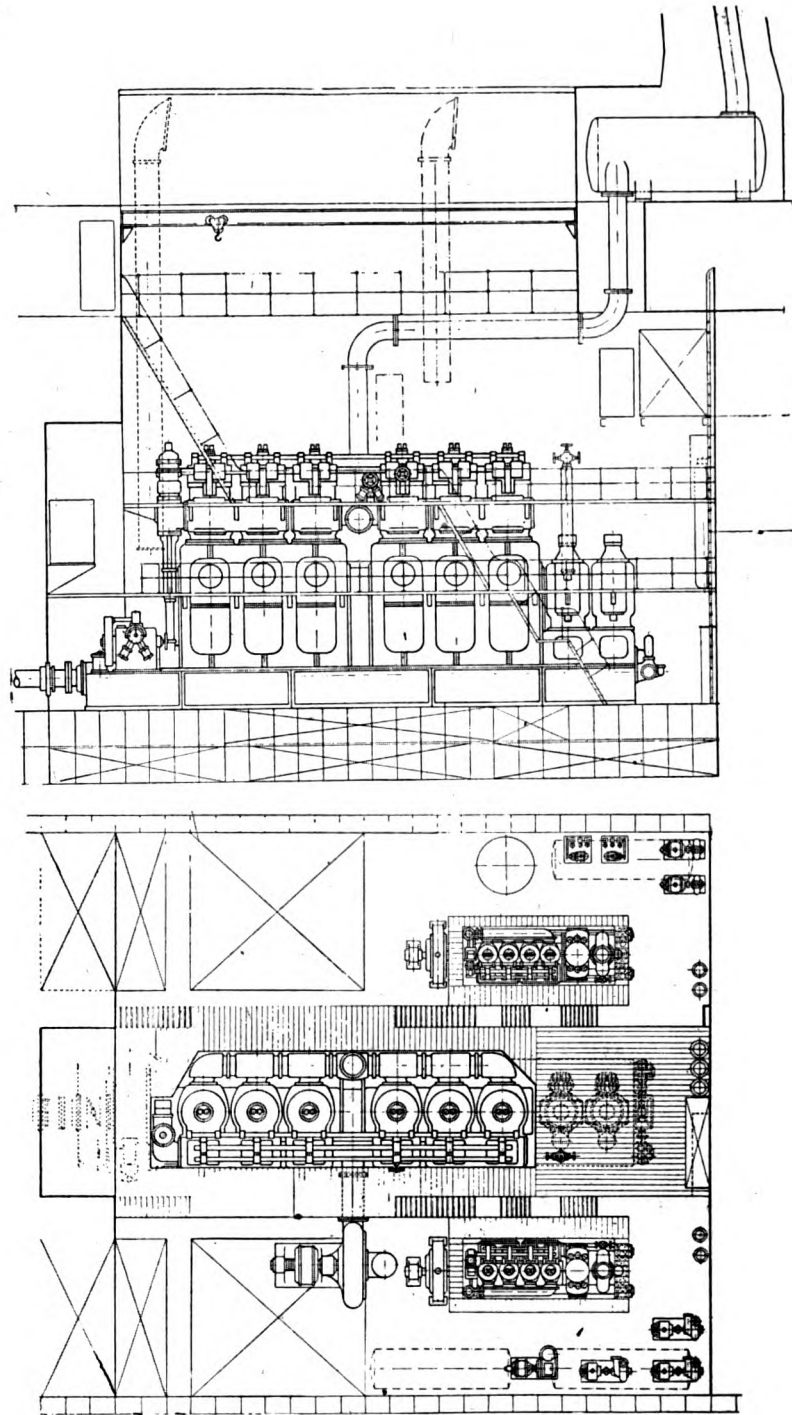
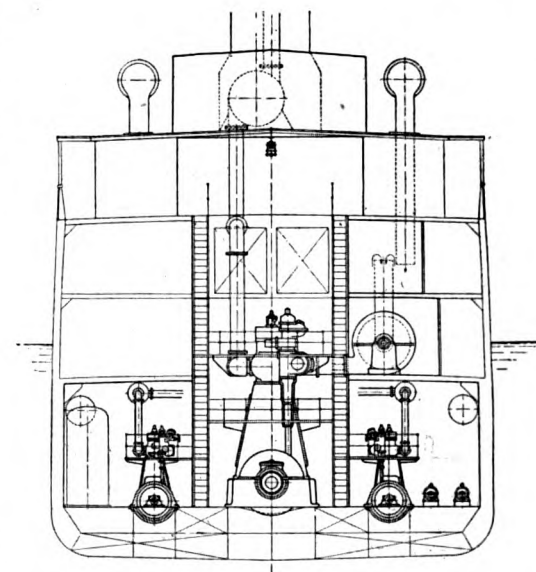


Fig. 8. Two-cycle 3200 b.h.p. single-screw Sulzer installation for comparison with twin-screw four-cycle plant of same power shown in Fig. 5.



to 42.4 cb. ft.) for storage room. The calorific value of a ton of coal is about 7 to 7.8 million calories (28 to 31 million B.Th.U.); a ton of crude-oil on the contrary has 10 million calories so that for the same total heating-value, crude-oil storage requires only 56 to 72% of the space required for coal. Per B.H.P. hour, about 1850 to 1950 calories (7400 to 7800 B.Th.U.) are required in a Diesel-engine as against 4200 to 6000

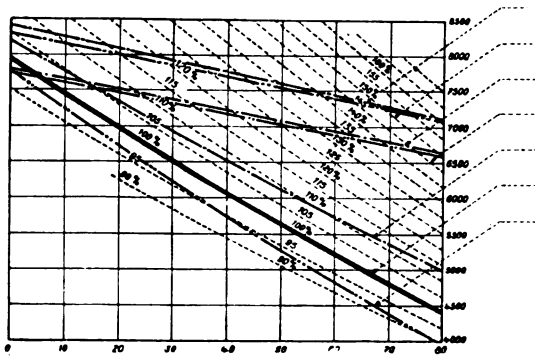


Fig. 9. Variation of cargo-carrying capacity with radius of action for different propelling machinery in a ship of 12,500 tons displacement

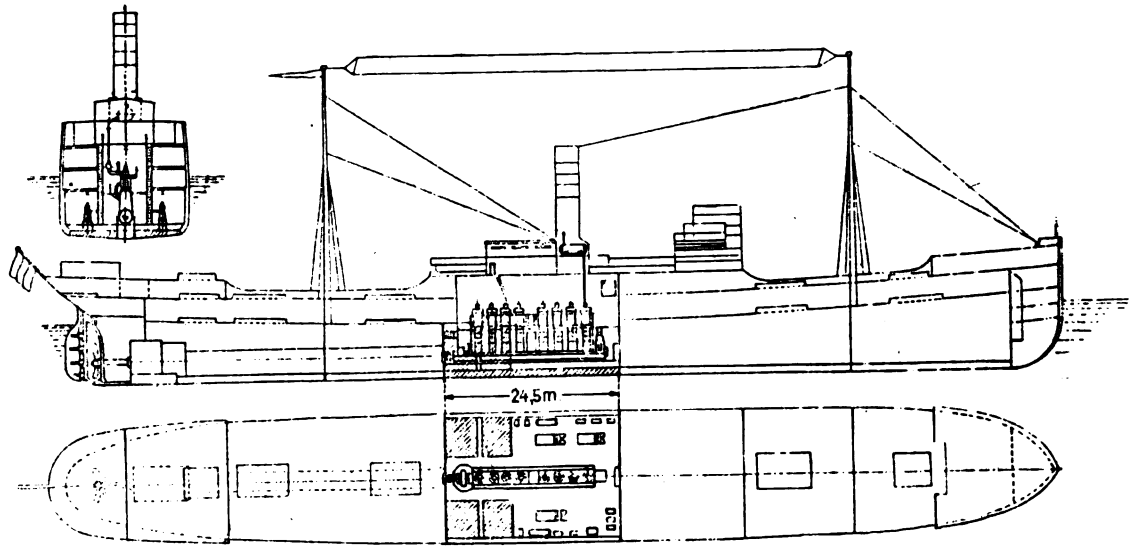


Fig. 12. Ship with four-cycle Diesel engine at 85 R.P.M.

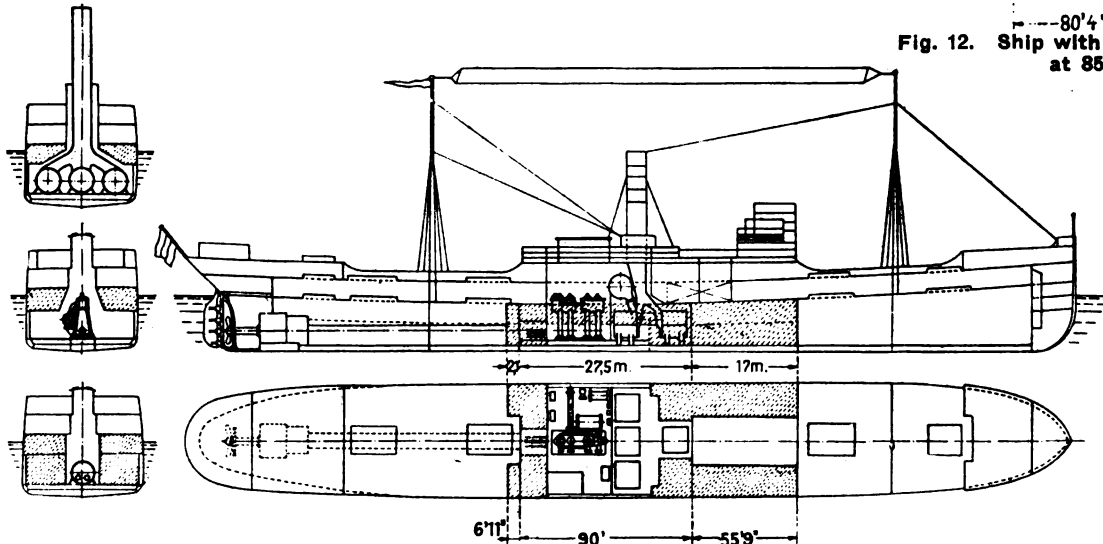


Fig. 10. Ship with steam reciprocating engine

case of a steam-engine, so that the storage room necessary in a steamer is 3 to 6 times that required in a motorship for the same number of H.P. hours.

The higher-speed Diesel-engines have the smallest dimensions of any of the systems

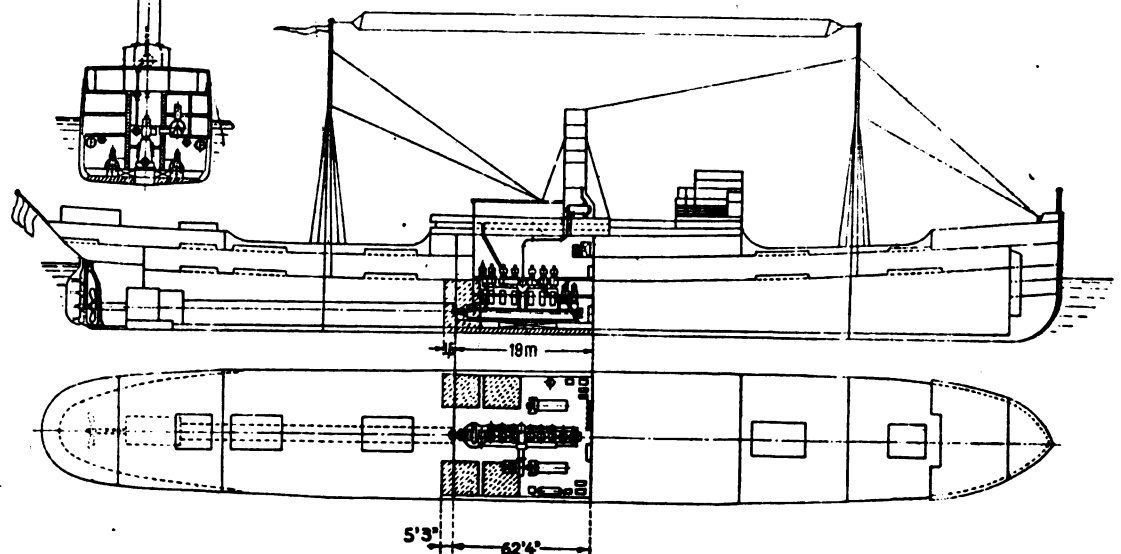


Fig. 13. Ship with two-cycle Diesel engine at 85 R.P.M.

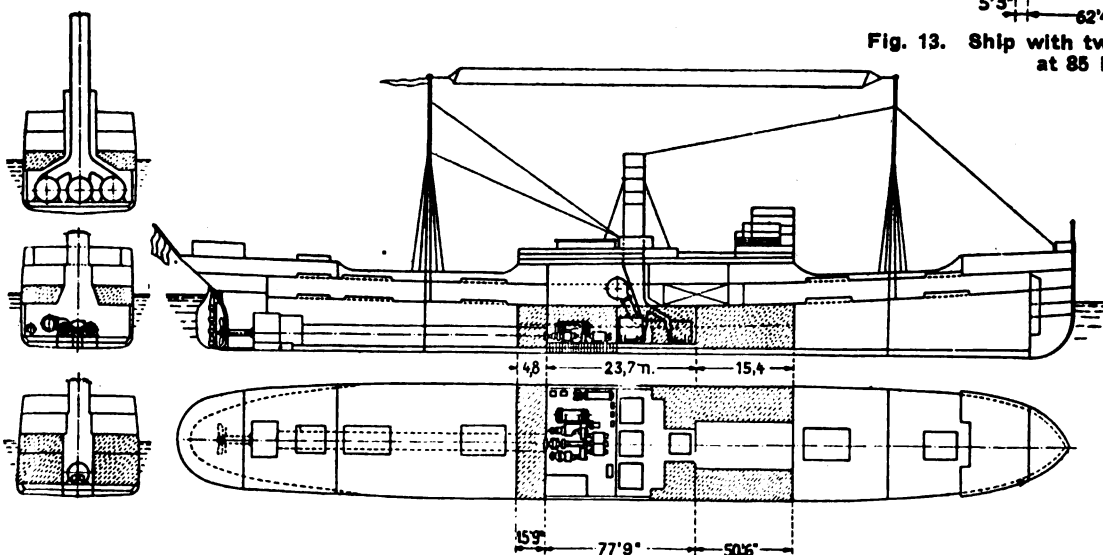


Fig. 11. Ship with geared-turbines

be greater, so that, taking everything into consideration the slow-speed Diesel-engine, which is also the better from the technical point of view, is decidedly the best machine to choose.

From what has been said above, it follows that the two-cycle engine in respect to

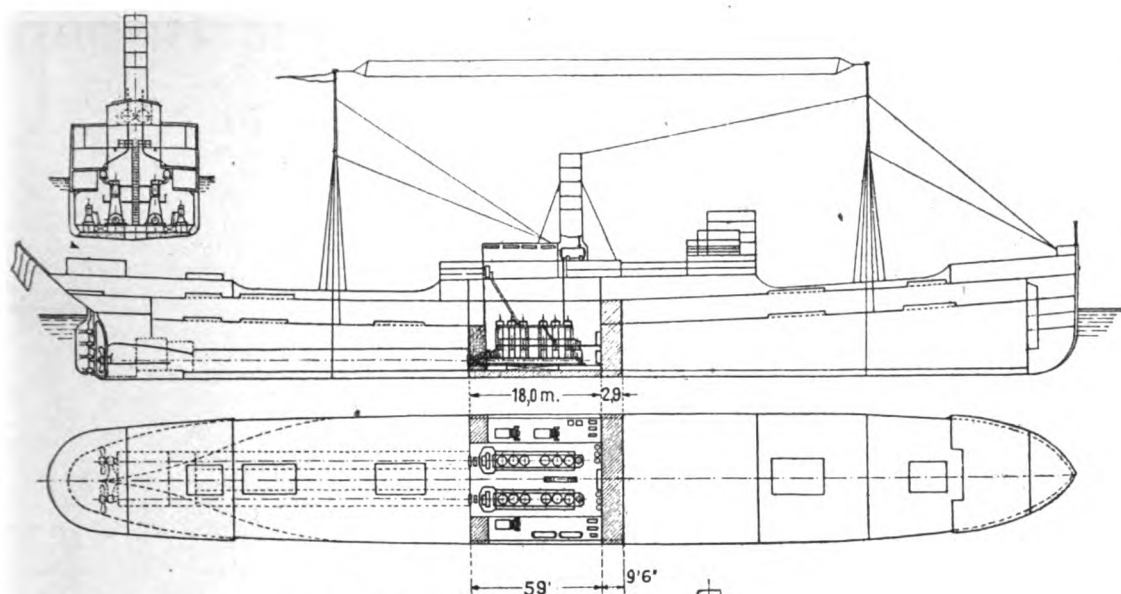


Fig. 14. Ship with four-cycle Diesel engines at 85 R.P.M.

dimensions and weight, and therefore also as regards prime cost, is far superior to the four-cycle machine. In considering the ship as a whole, with given displacement and fitted with two-cycle engines, it has a greater cargo-carrying capacity than if fitted with four-cycle machines. The machinery is lighter and costs less; and the tonnage available for freight is greater, thus increasing the earning power of the ship.

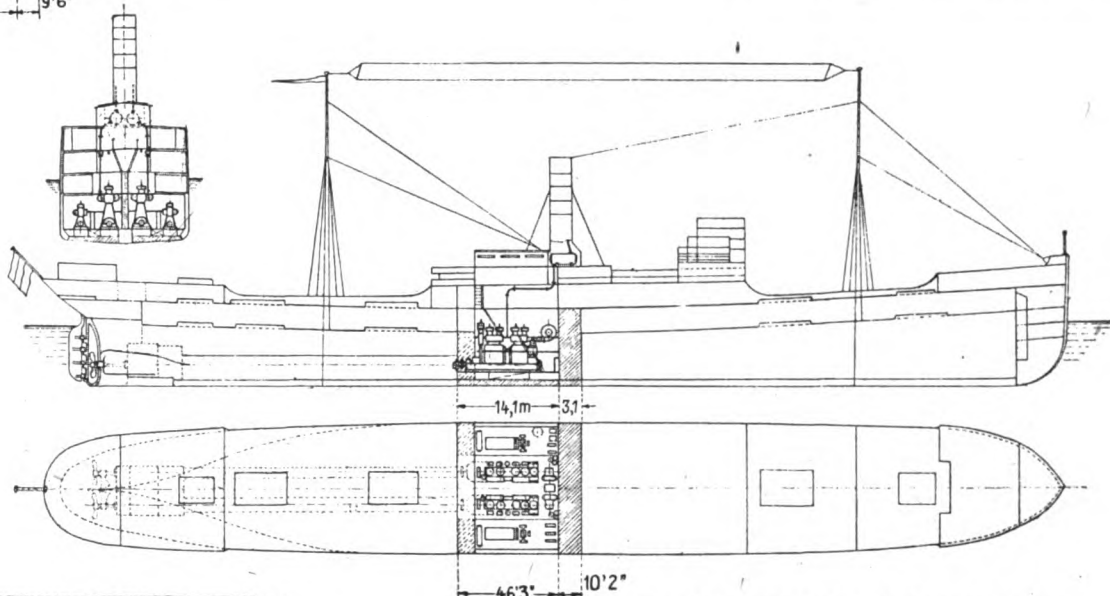


Fig. 15. Ship with two-cycle Diesel engines at 85 R.P.M.

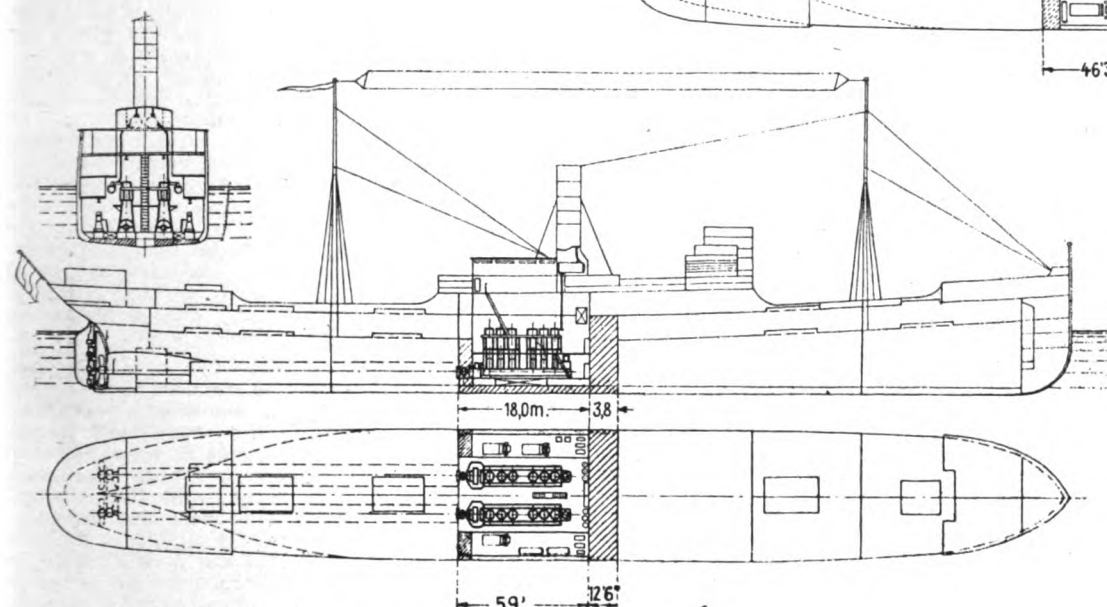


Fig. 16. Ship with four-cycle Diesel engines at 130 R.P.M.

The difference as compared with the four-cycle engine, and more particularly with the steam-engine, is so great, that it is undoubtedly the two-cycle engine which should be considered first of all for the propulsion of cargo-boats, when circumstances point to the desirability of motor-craft being used.

[While engineering firms frequently contribute letters to technical publications, a lengthy article is a *rara avis*, so the following contribution from the important Swiss company of Sulzer Frères no doubt has been read with one of the greatest of interest. In addition to having one of the largest Diesel-engine plants in Europe, Sulzers also have a large output of steam machinery, which makes their views on the comparisons all the more interesting.

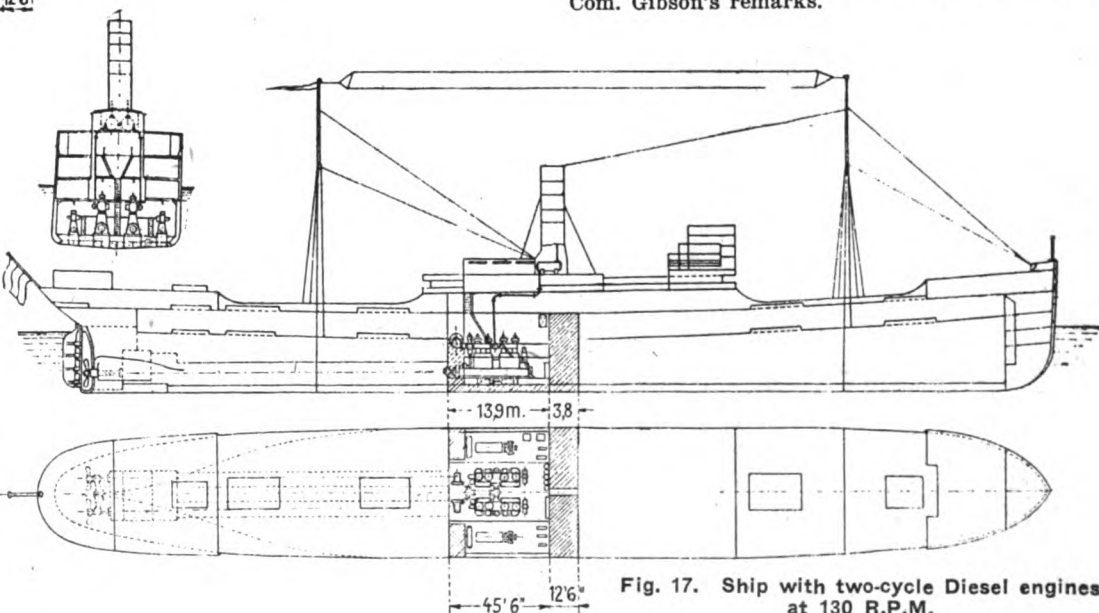


Fig. 17. Ship with two-cycle Diesel engines at 130 R.P.M.

Probably there are many points with which makers of four-cycle engines will be unable to agree, just as the two-cycle engine builders differed from the opinion of Mr. Torian's remarks in our issue of last January. Therefore we open our columns to other manufacturers and shipowners for comments on Sulzer's article.—Editor.]

THE 3,000 b.h.p. AUGSBURG SUBMARINE ENGINE

With reference to our article in the January issue, describing the 3,000 b.h.p. Augsburg Diesel engine of German submarines, Lieut. Com. Holbrook Gibson of the United States Navy has had an exceptional opportunity of making a thorough study of this engine and its smaller sister, whereas our own inspection was made under considerable difficulties. Lieut. Com. Gibson does not agree to the last paragraph in our article as follows:

"In this connection the question has been raised and the opinion expressed that Germany's submarine engines were not designed

for long life, but to fully and promptly meet an emergency. Already the machinery installed in some of the submarine boats has been found racked to pieces and ready for the scrap pile. More because they were designed for a short life of intensive use with the exception and purpose that both hull and machinery should be sufficient unto the hour of need and no more."

On the other hand he states that the machinery in the German submarine-boats is most carefully constructed and the utmost care was apparently used to make a finished product. There is not a single instance of a makeshift job of any kind, and I believe that while the engines were built to meet an emergency, they were designed particularly for submarine use, and as far as workmanship is concerned the German standards are more exacting than ours.

We are very glad to give publicity to Lieut. Com. Gibson's remarks.

Review of the Diesel Marine Oil-Engine in Great Britain and Its Adoption and Operation in General

By COSMOS

The Diesel Engine—The Steam Turbine

THE development and extension of application of the Diesel Marine oil-engine has been so rapid that not only is the whole history fresh in the minds of most engineers today, but the leading landmarks in its progression will very readily be recalled. Although this prime mover has achieved great strides in marine work, its adoption has lagged greatly compared with the enormous success at sea of the steam turbine. This is not greatly to be wondered at when it is recalled that with the adoption of the turbine no fundamental change was involved. The fuel, coal, and the working medium, steam, remained the same, the motion only being altered from reciprocating to rotary. The auxiliaries similarly remained identical in type. Most important of all the advent of the turbine made immediately possible the attainment of powers completely outwith the reach of the reciprocating steam or internal-combustion engine. This quality alone demanded the immediate application of the steam turbine to marine propulsion. Less courage is required to adapt a high-power machine for lower outputs than to apply a principle only proved for low power installation to greatly increased size, so that from a mechanical aspect the steam turbine for low powered vessels has become an active competitor in the field most suitable to the application of the Diesel engine, whilst the highest powers for which marine oil-engines have so far been built are relatively low.

Development in Britain

So much may be said by way of comparison of achievement merely to insure a true perspective. The Diesel engine is the newest prime mover, and only 22 years ago the first successful Diesel engine was constructed and run. Briefly the stages in the history of the marine Diesel engine in Britain may be traced. The development from 1897 to 1910 was slow and primarily concerned with land generator engines of quite moderate power. Until 1910 the relatively low cost of home produced coal and the uncertainties and high cost of the supply of oil-fuel from abroad prevented consideration of the Diesel for marine propulsion from coming prominently to the forefront.

Oil Fuel for Naval Work

From 1910 onwards the use of oil-fuel for naval vessels made great strides, oil was found to make possible improvements in fighting efficiency, such as increased power, speed, range of action, facility of bunkering, greater ease of bunkering at sea, together with decreased boiler repairs even when the steam generators were forced to an extent quite impossible with coal firing.

The acceptance of oil as a fuel for marine use, then, immediately brought into prominence the Diesel engine, which utilized the same range of grades of oil as the steam plant with a fuel economy unapproached by any other system. Some British marine engineers were not slow to turn their attention to the problem of adapting the Diesel engine in its state of development at that time to the difficult duty of ship propulsion.

Progress in Germany

Germany was the home of this type of prime mover and it was not unnatural to seek there for information upon which to base suitable designs of marine plant. Progress was being made on the Continent with both the four and the two cycle types. For marine work, undoubtedly, the two-cycle principle was favored, and many British firms took out licenses to build Continental two-cycle marine engines. Such a decision at that time by Marine Engineers is readily explained. The single-acting two-cycle principle gives a turning moment more nearly approximating to that of the reciprocating steam-engine than does the four-cycle. At the same time in Germany experimental work with double acting 2-cycle engines was being undertaken on a large scale. Hopes were entertained that this engine, which all felt to be the final solution especially for marine work, giving in reduced space and with less weight approximately the same turning moment as the steam reciprocating engine, would early become an accomplished fact. Germany, wishing to regain the supremacy in naval engineering that she had lost, due to her delay in adopting and developing the steam turbine, hoped by fostering intensive experimentation with the Diesel prime mover to regain first place. In this Germany failed. Several large double-acting engines were built. At Nurnberg, an engine of three double-acting cylinders developing some

thousands of horse-power was to be installed in a Cruiser to drive the centre shaft; but a serious accident connected with the scavenging system, and not directly involving the principles of the Diesel engine, had the effect of immediately suspending much work of a similar nature then in progress on the Continent. These large experimental engines, it may be noted, worked on the two-cycle principle. Little matter for surprise then that, at the stage in the development of the marine oil-engine (1912-1914) the 4 cycle principle was somewhat overshadowed by the 2-cycle. The trend of development pointed to the two-stroke-cycle and many British firms commenced the construction of marine 2-cycle Diesel engines under license.

The Double Acting Engine Foundry Difficulties

A number of sets of machinery were completed and went to sea. These engines were only moderately and partially successful. The principal source of trouble in construction in Britain was, no doubt, the difficulty experienced in obtaining from British iron foundries satisfactory castings of the intricate and complicated design, involving thin and thick metal in juxtaposition so much adopted by the Continental technician and so foreign to British engineering practice and foundry experience.

Early Performance at Sea

The performance of these early motor ships was closely watched and with several notable exceptions did not enhance the reputations of the Diesel motor for marine work. Only the most adventurous of shipowners then could take the courageous step of installing such engines in face of the facts and often greatly exaggerated rumors so current at that time as to breakdowns and troubles.

Then came the war. This brought the Internal-Combustion Engine into a greater prominence in the following four and a half years of intensive development than perhaps double or treble this period of normal progress would have effected. For submarines, aircraft, tanks, and many other purposes this type of engine performed in a manner worthy of the highest praise. So vital a part was played by the submarine, that the performance of the Diesel engine with which almost all were propelled was duly recorded. Of the fleets of Great Britain and Germany, by far the largest number and the highest powered submarines were equipped with four-cycle engines. The German pre-war 2-cycle development was prominently kept in view and extensive and attractive propaganda was undertaken to foster the policy of the granting of licenses, their pre-war 4-cycle engines, developing 1,000 B.H.P. in six cylinders were sound productions as regards both design and construction and were almost quite overlooked. During the war this engine formed the basis of their development towards higher powers. In Britain the standard submarine engine works on the same 4-cycle principle. It was built by 20 firms. Quite briefly these few extracts from past history trace the main developments to date.

Submarine Diesel Motors

Standard Marine Machinery Today

In Britain the standard marine machinery for small powered vessels is still the steam reciprocating engine. The double-reduction geared-turbine is now being almost exclusively fitted for medium and high powers. Relatively few marine Diesel engines are in construction and these are mostly of the standard 4-cycle slow-running cross-head type.

There is undoubtedly need for a considerable increase in application of this prime mover in view of the unquestionable economy of operation accruing from its installation. Let the case be stated thus: It is admitted that in the past there have been troubles and not infrequent breakdowns with marine Diesel engines involving shipowners in serious expenditure dependent in extent largely upon the loss of freights due to laying up the ship for repairs or renewals.

Source of Many Troubles

Such cases have occurred mostly with two-cycle engines, and were due generally to the too ready adoption of this system in preference to the less attractive 4-stroke cycle before the requisite knowledge of all the extra conditions of stress imposed by this policy was available. In deference to the opinion and experience of marine engineers designs of 2-cycle engines were altered to conform

in externals as nearly as possible to the accepted appearance of the standard steam-engine, which policy however in no way improved the reliability of this type of Diesel engine. Diesel ships were not infrequently run by engineers whose knowledge of the working of this prime mover was quite inadequate. Cases have not been lacking where marine Diesel 2-cycle engines have been taken out and replaced by steam plant. As is natural, much prominence was given to such instances. This is one side of the case. The other is that knowledge has been gained, and it can confidently be stated that the early difficulties have now been fully investigated, the causes amply ascertained and suitable remedies applied. Much progress, with the 2-cycle principle in particular, has taken place in the meantime. Like mistakes need not reoccur.

Experienced Engineers Available

Progress with marine and land internal-combustion engines during the war, as already stated, has been enormous, and the number of engineers to-day who are conversant with the main principles of their operation is a multiple of the approximate figure before the war. Therefore, there is certainly just cause for the closest investigation to-day by the shipowner of the advantages in fitting Diesel engines to freighters. It must be remembered that, of the advantages gained by adopting this means of propulsion, the saving in fuel-costs per ton-mile will amount to from 25 per cent. to 50 per cent., depending upon the basis of comparison, and is not by any means the only saving; although probably the most important. Why are so few Diesel ships in course of construction in Britain? The first deterrent is the comparative shortage of engineers conversant with the working of this machinery. This point has just been dealt with.

Mishandling

No engine is so susceptible to mishandling as the Diesel. There are a large number of somewhat intricate units of the machinery each of which are vital to the working of the whole plant, and any one of which, if allowed to operate at less than a fair percentage of full efficiency, can cause considerable trouble. It is only fair to state that the necessary adjustment of these parts is as readily remedied as they are liable to require attention. The engineers, however, must be as well trained to sufficiently expect observance in order that they will realize when attention and adjustment are required as they are versed in the means of carrying out that adjustment. The fuel-injection pumps delivering to the cylinder each working stroke of the engine their minute and exactly measured quantity of fuel-oil are a case in point.

Recommendations

The constructor should be prepared to send with the first Diesel ship of any shipowner a guarantee-engineer who will train the ship's staff in the special points, close observance to which will obviate the ship being held up due to machinery defects. This, after all, is naturally the principal fear of all shipowners when considering the adoption of any novel feature. If a ship is delayed due to breakdown, not only are dock dues to be paid, and the cost of replacement to be deducted from the profits, but the annual earning capacity of the ship is reduced in proportion to the duration of the delay. Little trepidation on this score need be felt at the present time. There is a good balance in favor of the Diesel engine. Firstly there is the time saved by bunkering with fuel-oil on account of the smaller quantity required for a given length of voyage, and secondly—the actual weight and volume of oil per unit of heat content is much less than that of coal as well as, of course, the much greater repetition, cleanliness and lesser cost consequent upon the handling of oil as compared with coal.

The Diesel in a Moderate Sea Way

Yet another point little appreciated, is that a Diesel in a moderate or a heavy sea will make a higher average speed than a steam reciprocating-engined ship of exactly the same propulsive power. The reason is, that the speed governor with such steam machinery only succeeds in regulating the speed of revolution within wide limits due to the large volume of steam in the engine at the time the governor—or more generally the junior engineer of the watch—cuts off the steam supply. When the propeller emerges the engine revolutions rise considerably and with re-immersion a time lag again occurs and the speed of revolution

falls much below the normal. With Diesel machinery, on the other hand, the governor acts immediately, cutting-off all the fuel supply to the cylinder, and the engine is much more nearly a constant speed machine giving consequently a higher average speed of ship "over the ground". This gain may be considerable depending upon the condition of the ship whether light or heavy laden and upon the weather if moderate or bad and varies from 5 to 15 percent.

Manoeuvring

Lack of manoeuvring capacity is sometimes claimed against the oil engine. No prime mover can compare with the steam engine in regard to flexibility. That must be admitted a priori. [Diesel-electric drive has about the same flexibility—Editor.] There has been a case of an oil-engined ship ramming the quay wall or other ship, due to failure of the engines to respond to the orders from the bridge, but that may have been the operator's fault.

Fundamentally the internal-combustion engine is a constant speed machine and can only be made flexible by the adoption of artifices and when handled with care and precision, as its power is generated within itself. The present design of reversible marine Diesel engines is not charged so much with a lack of flexibility as a possible recalcitration on occasions in obeying the operating gear. Certainty of response to the starting-handle is primarily a question of minute care in the design of starting-air valves and gear details, and might well form the subject of a lengthy treatise.

Starting Torque

Another distinct advantage of the Diesel engine, however, is that when responding to the telegraph either ahead or astern it does so in no uncertain way. The starting torque is greater than with any form of steam-engine, due to the summation of the torques, of the starting-air and of the fuel (in some cases in fact a slight overload of fuel). When running astern also in contra-distinction to turbine machinery where only some 50 to 75 per cent. at most of ahead power is available, the same power can always be given astern as for ahead when required. The result, as will be confirmed by those with experience in handling Diesel-engined ships, who appreciate and can take advantage of these properties, is that few manoeuvres and the minimum of time suffice to bring the ship into any desired position.

Towing

Every ship should be able to tow. This property may be required on occasions and lack thereof may involve serious consequences. Towing imposes a heavy load on the engine in that a higher torque than that due to the speed of revolution of the propeller is required to give capacity for towing. The designed proportions of the engine as equated to the propeller must be such that a load in excess of the normal by a considerable amount can safely be carried.

Reduction of Engine Room Personnel

Too much importance need not be attached to the possibility of the reduction in engineering personnel consequent upon the substitution of Diesel for steam machinery, excepting the elimination of the stoker. Whereas the steam engine is fitted as a single-screw installation for quite large powers, the Diesel engine with some makes is as yet so limited in power capacity per cylinder that twin-screws generally are fitted to give the power required for the desired speed, and with such an arrangement more engineers are required. The stokers necessary with coal-burning ships are, of course, dispensed with. The same would almost be the case with oil-burning steam machinery. It is not expedient as yet to reduce unduly the engine-room personnel with Diesel machinery which is new to a considerable proportion of qualified marine-engineers, to the complement that would suffice under the most favorable conditions. It is advisable to have a margin.

First Cost

The question of first cost must be considered, and, without going into all the aspects of the case or expressing confident hopes for the future, the Diesel system is always more expensive in first cost than steam machinery. The extent of the excess cost will depend upon the details of the plant, the quantity of engine being built at the same time, the type of drive adopted for the auxiliaries, and so forth. The interest on this excess cost must be balanced against the savings in operation. On the other hand, the Diesel ship carries more cargo, so the cost of the complete ship per cargo-ton is about the same.

Sufficient has been said to give a fair idea of the summing up of the case, as it appears at the present time, both from the point of view of the engineers advocating the Diesel system and of the shipowner considering its application to vessels of suitable power operating on routes where oil-fuel is obtainable at rates making attractive the saving in fuel costs per ton-mile. Suitable power means from 500 to 6,000 shaft H.P.

Summary

A summary of the conclusions has been attempted in the following:

The Queries of the Shipowner

Can oil-fuel be regularly obtained at prices favorable to the adoption of the Diesel engine?

Are there available engineers proficient to run such engines successfully?

The Replies of the Engineer

Undoubtedly, since so many steam vessels are being fitted for oil-burning at the present time.

The number conversant with internal-combustion prime movers is steadily increasing. A guarantee engineer will be sent with the first ship to train the engineers, and steam-engineers can be trained at the Diesel builders' works.

Is the high first cost of the machinery justified?

Will the Diesel engine answer the requirements of manoeuvring?

Is a Diesel-engined ship suitable for towing?

Yes, in view of the savings in fuel, space and weight, no firemen, increased speed in bad weather, no harbor standby losses, less time required for bunkering, increased cargo capacity, etc.

This is merely a question of the detail design of starting-gear, which is now well understood, and care and precision in operation. There is full-power astern, a large starting torque and rapid reversing.

Yes, if a good margin of power over and above the normal output of the engine is available, which in any case is a wise policy.

Reliability

Is the Diesel engine sufficiently reliable or will breakdowns occur and affect seriously the earning capacity of the ship?

This last question, then, is the crux of the position. It can only be answered either by the statement of an absolute guarantee apart from the usual clause in most contracts whereby the manufacturer undertakes full responsibility over a given period, generally 6 to 12 months, to make good at his own expense damage caused by defective material or workmanship.

Guarantees

With increasing knowledge and the large amount of splendid records of performance of Diesel ships a rigid guarantee of full compensation for any losses consequent upon a ship being laid up, can hardly be expected, and will very seldom be conceded. In the past on certain occasions arrangements have been made whereby the constructors have shared the responsibility and the profit with the owners. Such arrangements are to be commended in any new industry for their boldness and enterprise.

Conditions of Progress

Progress will be gradual but sure, and the rate and extent will be in measure dependent upon the dissemination of knowledge amongst the leading and more enterprising shipowners. A ridiculous amount of reticence and even secrecy has been observed in the past in regard to the design and operation of Diesel engines; which has retarded their adoption to an extent much greater than has generally been supposed. Let facts be given, however unpleasant, since only in this way can the solid basis of confidence necessary for the merited application of the Diesel principle to marine work be built up. In this policy "The Motorship" has played a leading part and in the near future I hope to contribute further articles dealing in detail with many of the vital points raised in this general survey—Cosmos.

The "Tanjong Rhu" and the "Tanjong Kling" American-Engined Oriental Ships

Unfortunately, the illustration which we give on this page of an interesting Oriental motorship is not very clear, but it will give a comprehensive idea of the design and construction of the wooden motorship "Tanjong Rhu," built last year by the Anglo-Chinese Steamship Company, of Singapore, Straits Settlements, from designs by Mr. Graham Hutchinson. Together with the sister motorship, "Tanjong Kling," she was launched in September, 1918. It is possible that they marked the era of motorship building in Singapore.

We referred to these vessels in a recent issue. Their dimensions are as follows:

Length B. P. 230 ft.
Breadth (moulded) 42 ft.
Depth of hold 22 ft.
D. W. C. at loaded draught 2,400 tons

Both ships were built to Lloyds highest class for wooden-ships and are rated A1 for twelve years, the exterior is of teakwood throughout with framing of hardwood. The engine installation consists of two 500 shaft horsepower Skandia surface-ignition type oil-engines, built by the Skandia Pacific Oil Engine Company, of Oakland. These engines give the vessel a designed speed of 10 knots, but on the trial trip an average speed of 10 1/4 knots was registered by the "Tanjong Rhu." The fuel-tank capacity is 200 tons.

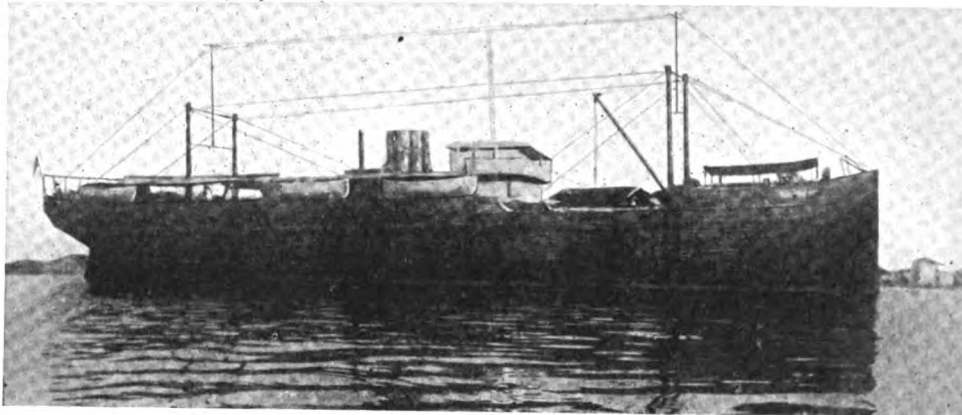
Unlike the majority of modern motorships steam auxiliaries are fitted, a vertical Wallsend

donkey-boiler being on deck at the forward end of the ship, and furnishes steam for six cargo winches working three hatches. As this donkey-boiler uses nearly as much fuel as the main propelling engines, it would have been more economical to have fitted Diesel-electric motor auxiliaries. She is a passenger and cargo liner, stateroom

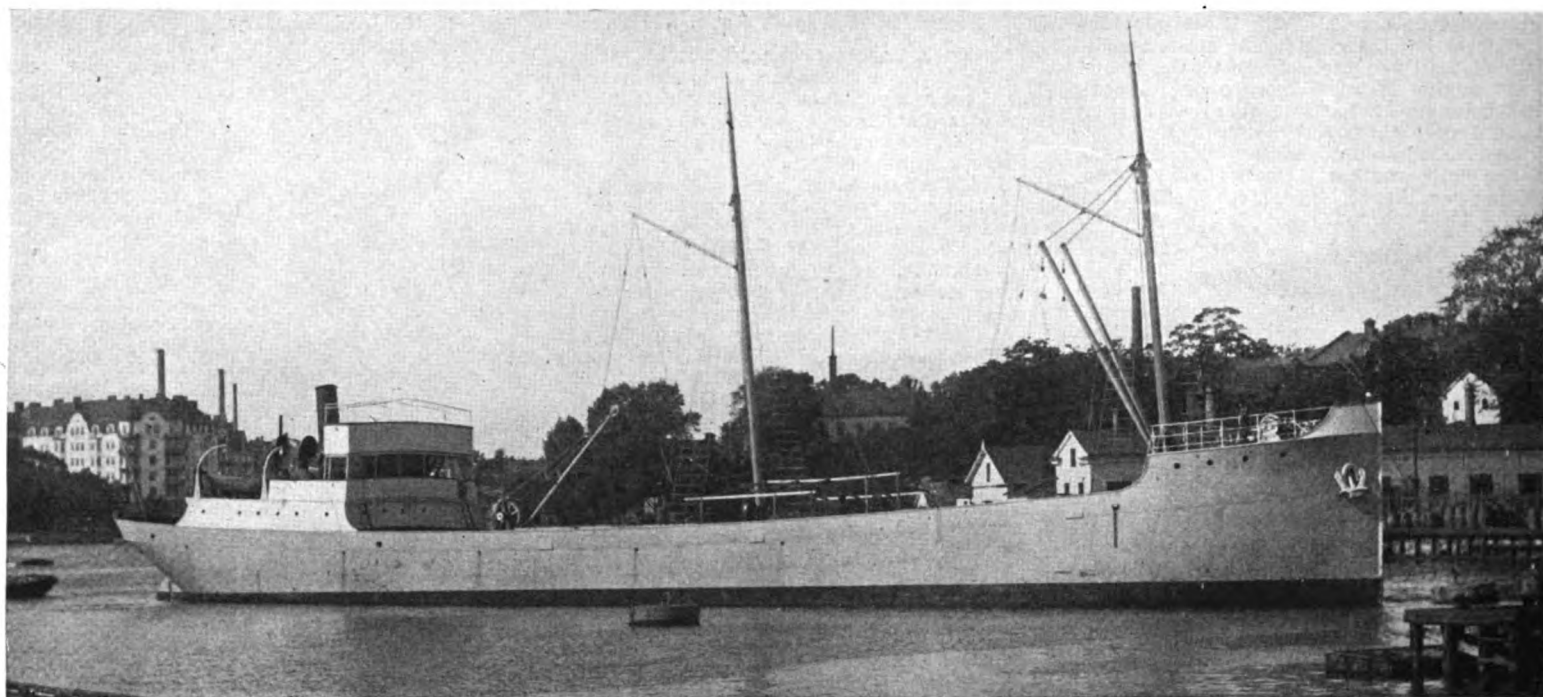
accommodation being provided for 20 first-class under the bridge-deck amidships, with the first-class dining saloon under the bridge deck at the fore end. In addition there is accommodation for over 300 third-class passengers on the main deck aft. Accommodation is also provided for a crew of 40, including F. D. Lewis, the captain of the ship, and D. Inglis, Chief-Engineer.

MR. T. A. PETERSEN'S ADDRESS WANTED

Will Mr. Petersen of Norfolk, Va., kindly send us his present address, as the Post Office at that city advises us that he has moved.



The wooden passenger motorship "Tanjong Rhu"



The motorship "Samur" built and oil-engined by the Bergsunds Mek. Verks. of Stockholm.

Marine Oil-Engine With Outstanding Features

An Interesting Swedish Surface-Ignition Type Motor Which May Soon Make Its Debut Here

NOT so very long ago we indicated that one of the valuable functions of the technical press was to reveal what was taking place in the way of engineering developments on the other side of the world to the advantage and education of both domestic users and makers. Some of us will remember how in 1910 the Western Hemisphere, also shipowners of Great Britain, were startled to learn that 5,000-tons Diesel-driven motorships then had been in service on Russian waters for seven or eight years. Outside of Russia no one knew that such developments with the heavy-oil engine been had made, and it was due to a British shipowner named Harry Lane and an enterprising Anglo-American engineer and journalist named Crowley, who went to Russia, that the American and British marine publications were able to reveal details. So, that time the technical-press was caught napping, although it served the purpose of distributing the information. But, it was the story of these unique motor-vessels, followed by the advent of the pioneer



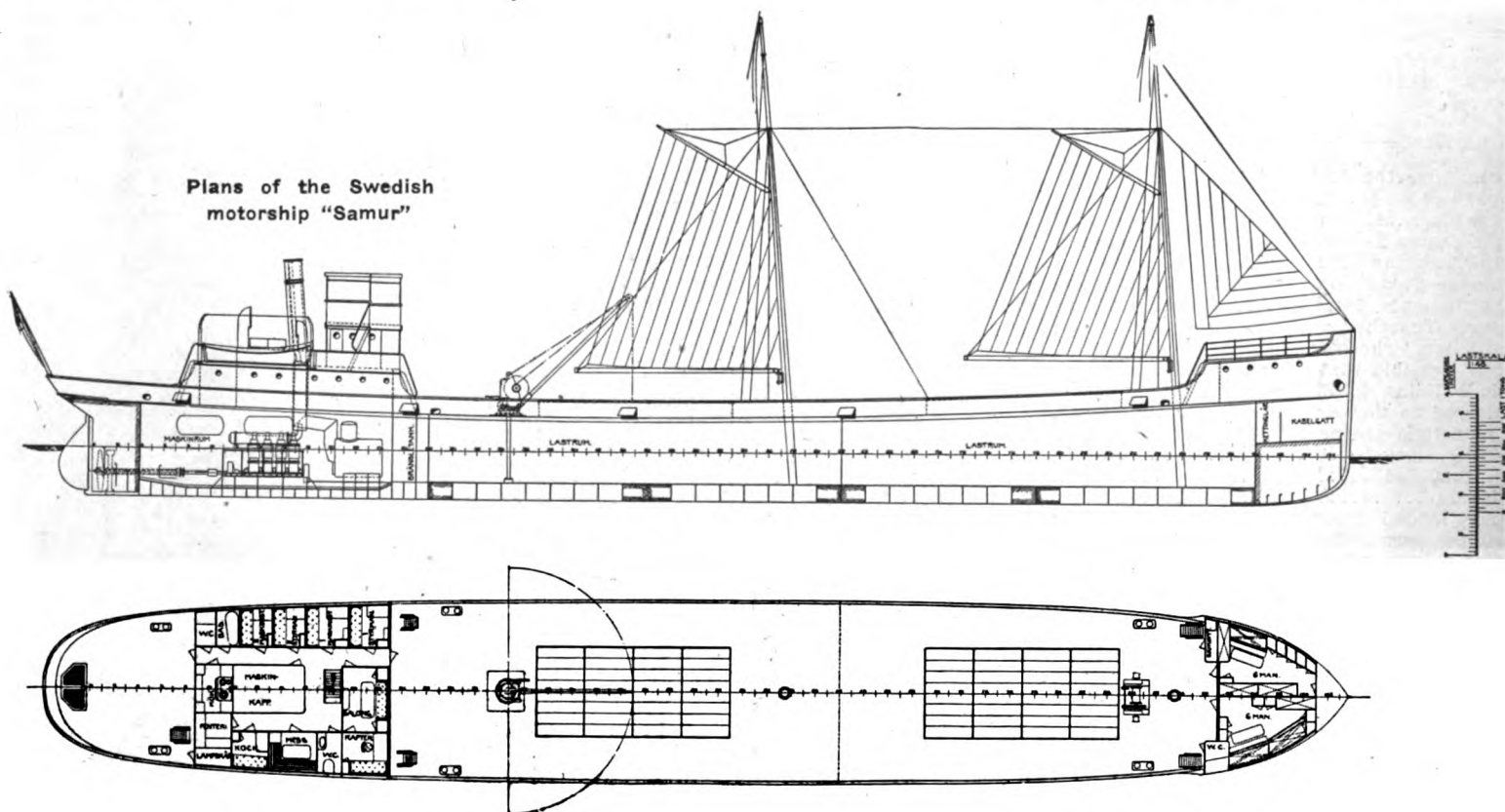
A 72 h.p. Bergsund oil-engine is installed in this little auxiliary schooner.

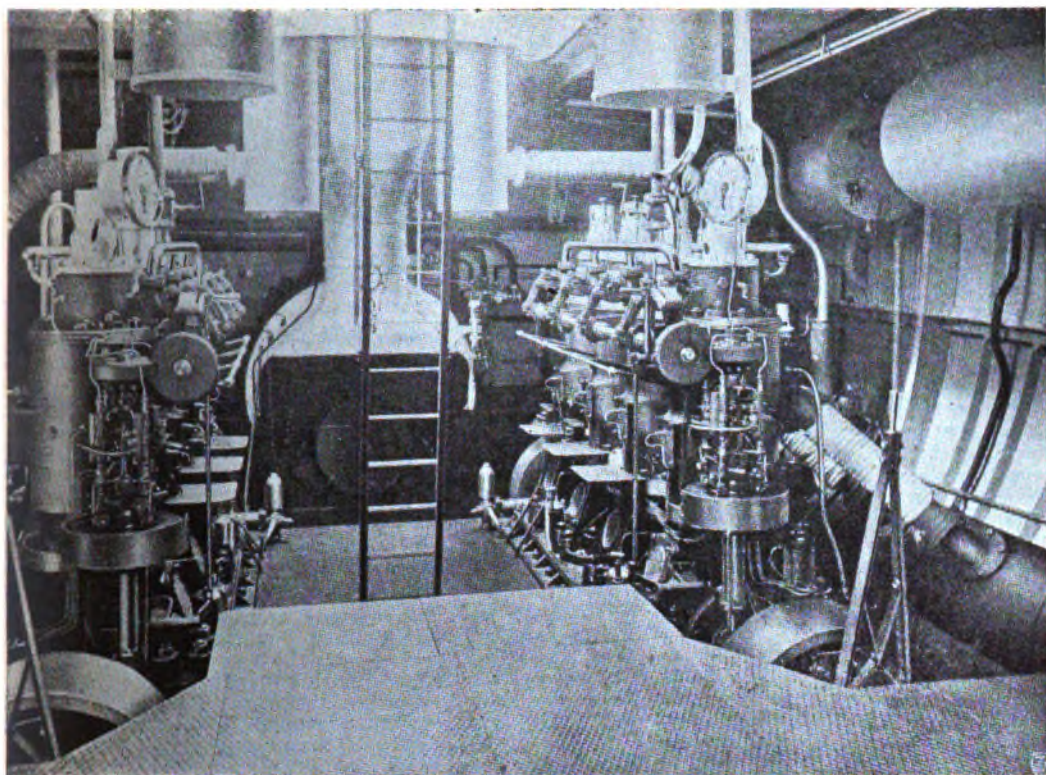
ocean-going motorships "Vulcanus" and "Selandia," that caused the Diesel-engine to become one of the most discussed subjects in shipping and engineering circles.

Since then the word "Diesel" has remained upon the lips of every man interested in ships or in machinery for their propulsion. For, during the period that the earth was in the throes of a great war, the importance of which outweighed all other matters, "Motorship" succeeded in keeping the Diesel-engine and motorship constantly to the fore. And, without the untiring campaign we have sustained for the past four years, there would to-day be very little interest taken in marine oil-engines in this country, whereas the industry now has firmly established itself on a foundation of solid rock, and soon will be the most important in the marine field, once more illustrating the highly valuable functions of the technical-press.

In various parts of the world there are oil-engines in service in thousands of ships and commercial boats, the names of which we rarely hear.

Plans of the Swedish motorship "Samur"





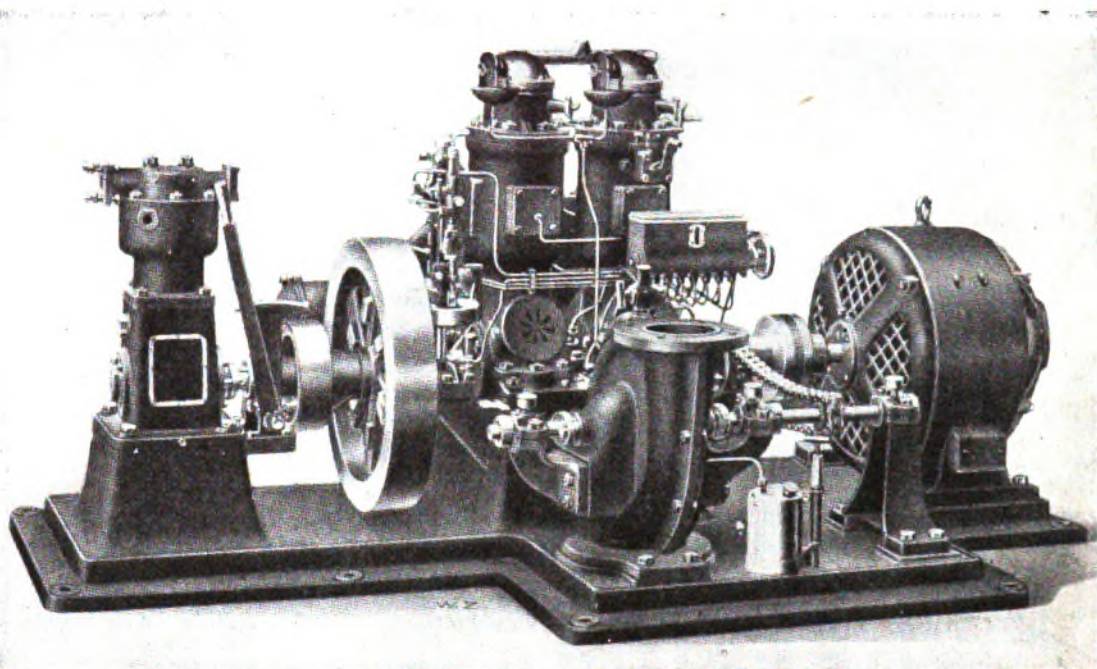
Engine-room of the motorship "Samur."

A typical case is that of the Bergsund-Original motor, which in Sweden is one of the most important surface-ignition marine oil-engines in use, being installed in hundreds of craft up to 1,000 tons d.w.c., but is an engine practically unknown in this country. However, as it is likely to be introduced to the American market very soon, some particulars will be of interest, especially as it has some novel features.

When we were in Sweden we were enabled to obtain some details of this engine and illustrations of many of the motorships in service, but owing to great pressure on space we have been unable to publish the same previously. Curiously, one of the Bergsund-Original oil-engined vessels was built for Russian interests for service as a tanker on the Caspian Sea and River Volga. This is the "Samur," which has the following dimensions:

Length (O. A.)	212 feet
Length (B. P.)	205 feet
Breadth (Max)	30 feet
Moulded depth	13 feet
Draught with 1,000 tons of cargo	11 feet
Power	360 B.H.P.
Speed with 600 tons	8½ knots

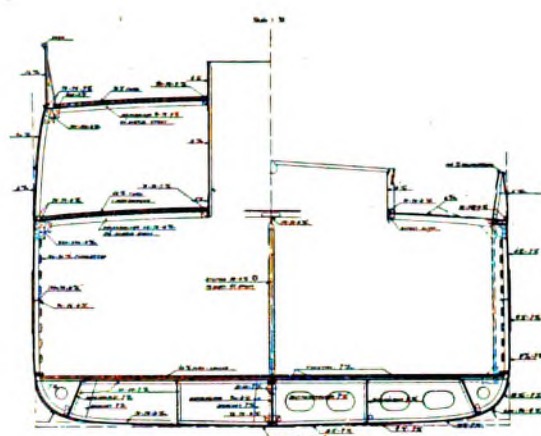
The propelling machinery consists of two 4-cylinder two-cycle motors developing 180 brake horse-power each at 260 rev. per minute. They



A neat air-compressor, bilge-pump, and electric-lighting set built by Bergsunds Company



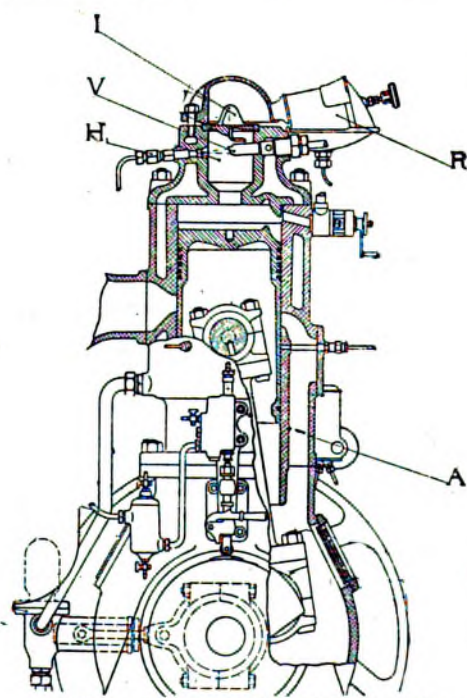
The Bergsunds deck-winch for small motorships. It is direct-driven by an oil-engine



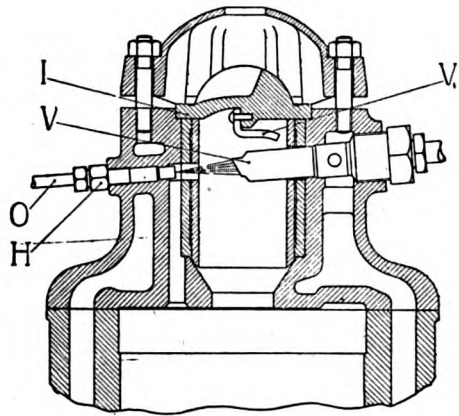
Section of the hull of the motorship "Samur."

are directly reversed by means of compressed-air and from full-speed ahead to full-speed astern takes only about 3 or 4 seconds. For the ship's lighting, signal lanterns and the searchlight, a 7½ H.P. Bergsunds motor is direct connected to a generator.

In comparison with the weight of an equivalent steam-plant the motors are especially suitable in instances of this kind where a large cargo capacity is desired with a minimum draught, the weight of the main motors being only 25 tons. The available space for cargo is also increased by



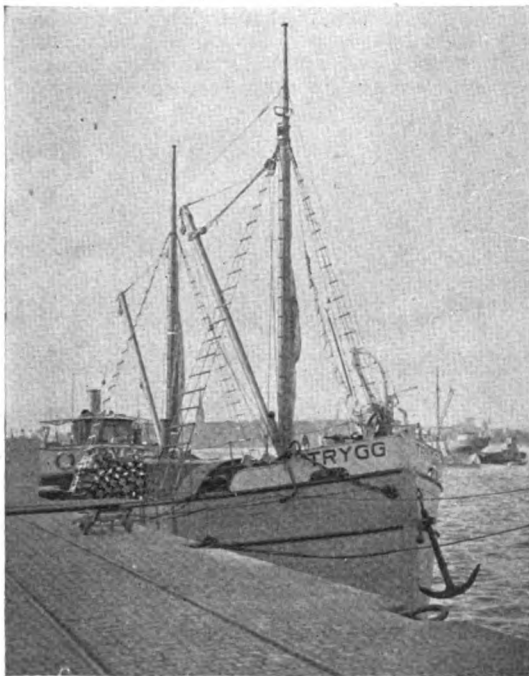
Section of Bergsunds Original engine



Section of hot-bulb and cylinder head.

the minimum space required by the motors. With the fuel-consumption of 0.53 lb. per shaft horsepower hour, or a total of 190 lbs. per hour for the two motors, cheaper operating-costs are obtained than with any kind of steam motive-power.

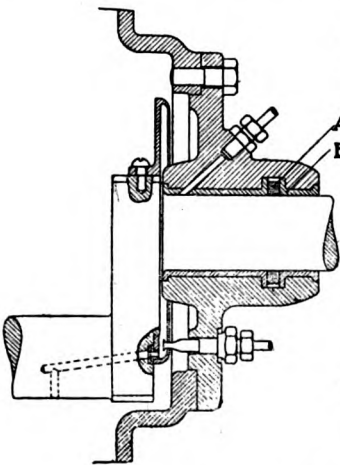
The builders of this oil-engine are the Bergsunds Mekaniska Verkstads Aktiebolaget (Bergsunds Engineering Works, Ltd.), Stockholm, 15,



A Bergsund-engined 300 tons wooden coast-wise vessel. A three-cylinder 135 h.p. motor is installed.

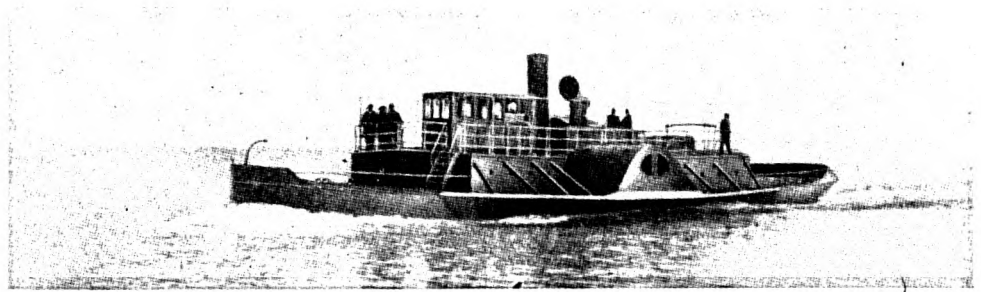
Sweden, who also have a shipyard where they construct the hulls of many of the steel and wooden vessels in which their motors are installed.

Generally speaking, the cycle of operations for combustion and exhaust follow the practice of other heavy-oil-engines of this class, and the sectional drawing depicts its leading features of design. Fuel-oil is injected by the pump into the



Oil-tight main bearing of Bergsund's engine.

hot-bulb "T" via the injection-nozzle "H" immediately before the piston reaches top-center, and is sprayed on to the surface of the projecting surface "V," which is heated when starting by transmission of heat from the double-lipped disc "I," which is made red-hot by the blow-lamp "R." After the engine has been running a short time, the blow-lamp is extinguished and the projection "R," and the ignition-plate, are



The "Wogul,"—An unusual type of boat—a side-wheeler driven by a 180 h.p. Bergsund's reversible surface-ignition oil-engine.

kept hot by the temperature of combustion. It will be noticed that both the hot-bulb and cylinder head are water-cooled.

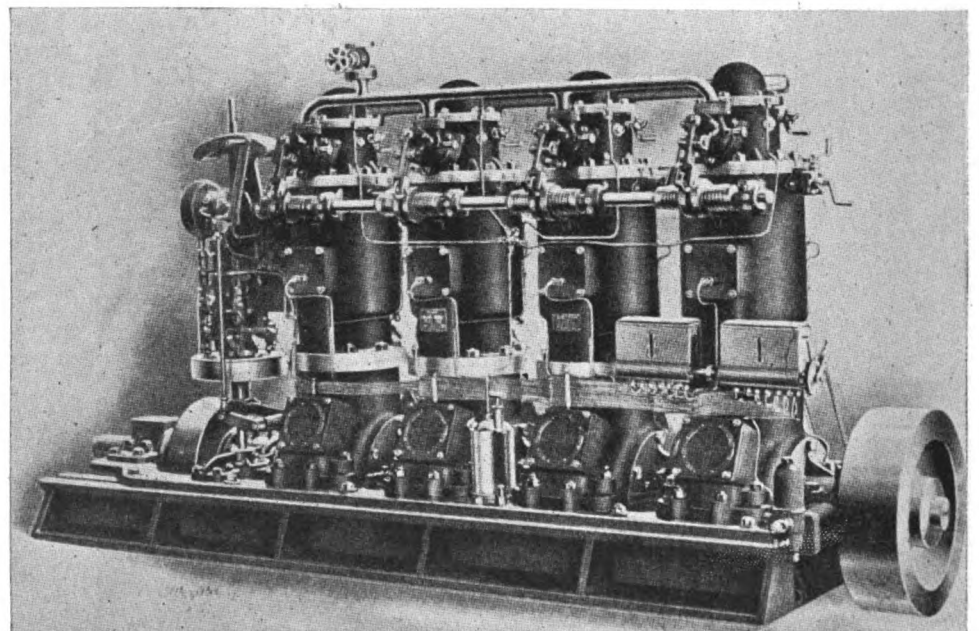
The projecting-piece "V" has a double duty as the fuel is sprayed on it at an acute angle in an almost solid stream, and is split by it into fine particles. And, in order to avoid chance of miss-fire at light loads, the lipped ignition-disc "V₁" termed the "light-load ignition surface," is fitted just above it, and this enables the engine to run for long periods without load, or without the use of the blow-torch.

Fuel is fed to the injector by the pump "A," which is actuated by a cam on the governor. The governor regulates the position of the cam in such a manner that the stroke of the pump is suited to the load of the engine, hence the quantity of the fuel being varied. Before entering the cylinder, the fuel-oil is passed through to separate filters, one of which may be taken out and cleansed while the engine is working. All troubles from the choking-up of the fuel-oil valves and the nozzle are obviated by this arrangement.

Lubrication of the various bearings and the cylinder is effected by a gear-pump, which automatically forces the oil to the places requiring lubrication, and the feed can be adjusted according to the particular requirement of oil at each spot. As the crank-case also serves as compression space for the scavenge-air, it is necessary that the main-bearings be provided with the air-tight joints. The arrangement made for this purpose is shown, and consists of a metal-collar, "A," which is carefully fitted in a groove in the main-bearing brasses "B," besides fitting closely on the crank-shaft. The groove being deeper than the collar, the latter retains a tight fit independently of the wear of the brasses. The lubrication of the bearing is accomplished through a valve in the bearing-cap.

GRANGESBERG ORE CO.'S BIG MOTORSHIP FLEET

The total number of large Diesel-driven ships now on order for the Trafiktiebolaget Grangesberg-Oxelösund, of Stockholm, Sweden, now consists of 12 craft—six at the Burmeister & Wain yard and six at the Götaverken (Göta Yard) Gothenburg. Many more ships are on order for future delivery, but the type of power has not yet been decided, although there is little doubt but that Diesels will be installed.



The 240 b.h.p. Bergsund direct-reversible marine heavy-oil engine.

POSSIBILITIES OF MOTORSHIPS FOR MEDITERRANEAN TRADE

The Swedish Lloyd S. S. Line is studying the question of motorships for the Mediterranean trade and have designed a special Diesel-ship of moderate size for the same.

REORGANIZATION OF THE STILL ENGINE COMPANY

We have just received word from England that the Engine Development Company, Ltd., who have developed and produced the Still combination steam and Diesel marine oil-engine, has been re-organized under the name of the Still Engine Company, Ltd., with a capital of £300,000, of which nearly one-half was issued fully-paid. The issue of the prospectus was made on February 14 last.

The new company will control the whole of the British, Colonial and foreign Still patents, with the exception of the Japanese rights, which have been disposed of. The directors of the new company are as follows:

James Brown, C.B.E., Managing-Director of Scotts Shipbuilding & Engineering Co., Ltd., Greenock.

Major Clement Haughton Langston Cazalet, D.S.O., Oaklands Lodge, Leigh, near Reigate, Chairman of Savilles, Ltd., Manchester.

James Esplen, of Messrs. William Esplen, Son & Swainston, Ltd., 22 Billiter St., London, E. C., Consulting Engineers and Naval Architects.

Stuart Hogg, 54 New Broad St., London, E. C., Director of Messrs. Chas. Butters & Co., Ltd.

Edmund William Janson, 18 St. Swithin's Lane, London, E. C., Civil Engineer.

Lt.-Col. Arthur Kempster Leslie, 29 Bolton Gardens, S. W. 5, Director of National Oil Refineries, Ltd.

Edwin L. Orde, Local Director of Messrs. Sir W. G. Armstrong, Whitworth & Co., Ltd., Newcastle-on-Tyne.

Up to the present time over £100,000 has been expended on this engine. Four licenses have already been granted in Europe, in addition to the Japanese license, as follows:

Messrs. Sir W. G. Armstrong, Whitworth & Co., Ltd.

Messrs. William Denny & Brothers, Ltd., of Dumbarton.

Messrs. Scotts Shipbuilding & Engr. Co., Ltd., of Greenock.

Le Societe Anonyme des Ateliers et Chantiers de la Loire.

Furthermore, negotiations are now in progress with the Svenska Aktiebolaget Nobel Diesel.

New Lumber-Carrying Motorship

"Donna Lane" Another Diesel-Engined Wooden Vessel Built on Pacific Coast—Sister Motorship Nearing Completion

In direct contrast to the Government's wooden steamships, which were condemned by us before a single hull was laid down, all the full-powered motorships of wooden construction built on the Pacific Coast have been so successful that large vessels of this type are still being built and completed. A typical instance is to be found in the fleet of nine McIntosh and Seymour Diesel-engined wooden cargo vessels of the Chilberg Line, purchased from the Australian Government by Seattle financial interests just as this unusual fleet was nearing completion.

Another case to be quoted is that of two more large wooden motorships nearing completion at Seattle, one, the "Donna Lane," being further advanced than her sister, having been launched on November 15th last. Originally they were contracted for by Christopher Hannevig & Co., Inc., of New York, but taken over by the J. H. Price

Auxiliary sails will be carried, but we presume that these will rarely be used, as unless of large area would be of little use except with a strong, fair wind. Both ships will be used in the trans-Pacific trade, running between Seattle, Australia and the Orient, on which routes their large cruising radius with a small bunker capacity will be of great advantage. In view of the high cost of sails and rigging, we consider that in this particular case the money would have been better spent in having the Diesel-engines of little higher power, as although we understand the speed of 10 knots has been guaranteed, we doubt if her loaded-speed could average more than 9 knots, even were the sails of a little assistance. This, of course, applies to any kind of power-steam or Diesel; only with steam machinery maintaining an average speed of 9 to 10 knots would mean too large a consumption of fuel to render her operation on the foregoing long-distance route a good commercial investment.

NATIONAL MERCHANT-MARINE EXPOSITION

Revised Programme for National Marine Week in Connection With Above Exhibition at the Grand Central Palace, N. Y.

MONDAY, April 12—

1 P. M.—Inaugural luncheon aboard an American ship in New York Harbor, at which the ceremonies of the week will be opened formally by the Secretary of Commerce and the Chairman of the Shipping Board.

4 P. M.—Formal opening of the National Marine Exposition by the chairman of the Shipping Board at a private viewing, Grand Central Palace, New York.

8 P. M.—Shipbuilding Night at the Exposition.

TUESDAY, April 13—

7 P. M.—Annual Dinner of the National Marine League, Commodore Hotel, New York. Speakers will include the Secretary of the Interior and the Chairman of the Shipping Board.

WEDNESDAY, April 14—

8 P. M.—Engineering Night. Special lectures and motion pictures at the Exposition.

THURSDAY, April 15—

8 P. M.—Travel Night. "Travel in American Ships," featured as a slogan at dinner and celebrated under the auspices of the Travel Club of America.

FRIDAY, April 16—

8 P. M.—Fuel Night. Special lectures and motion pictures at the Exposition.

SATURDAY, April 17—

8 P. M.—Merchant Mariners' Night. Special films and features to stimulate recruiting of Americans for the merchant marine service.

THE SABATHE "DIESEL" ENGINE

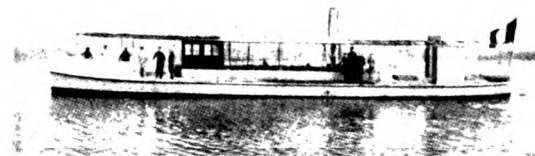
We have received the catalogue of the Société des Moteurs Chaleassiere, of St. Etienne, Loire,

France, builders of the well-known marine and stationary Sabathé "Diesel"-engines of both two and four-cycle types. It may be remembered that this engine differs slightly from the usual Diesel cycle, as when the injection-valve starts to open only a small quantity of fuel is blown into the cylinder, producing ignition at constant volume. As the spindle of the injection-needle lifts, projections on the same lift the main injection-valve and the remainder of the fuel is blown in, producing and completing the combustion at constant pressure.

We understand that the shops and products of the company have recently been reorganized from war-work, and that they are devoting considerable activity towards developing the marine Diesel-engine department of their business. For cargo-ship work their engines are rated in six sizes from 750 shaft horse-power to 3,000 shaft horse-power. The smallest ship-engine is a three-cylinder model 550 mm bore by 750 mm stroke, turning at 160 R.P.M. The largest engine is a six-cylinder 3,000 h.p. model 700 mm bore by 920 mm. stroke, developing its rated power at 130 R.P.M. We also note that for smaller craft, such as fishing vessels, etc., they build four models, each having an output of 25 horse-power per cylinder.

NORMAND MARINE DIESEL-ENGINE CATALOGUE

We have received an exceedingly attractive marine Diesel-engine catalogue from the firm of Augustin Normand of Le Havre, France. It is beautifully illustrated with photographs and draw-

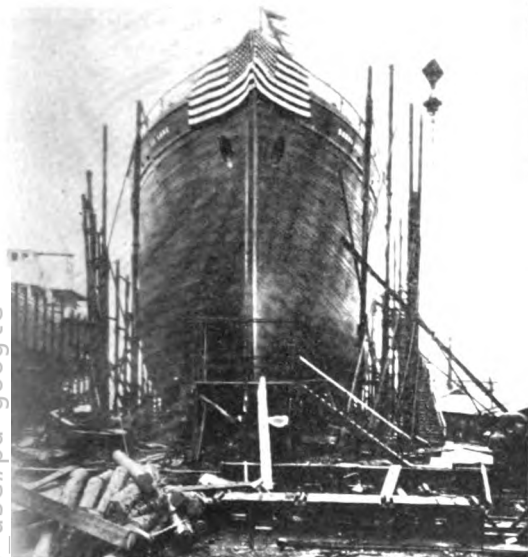


"Colonial," a little motor vessel fitted with a 400 b.h.p. Normand Diesel engine.

ings of their engines and with plans of merchant motorships which they have designed.

We note that their two largest engines are of the four-cycle type and one is a six-cylinder model, 660 mm bore by 1,000 mm stroke, turning at 110 to 125 R. P. M., while the other is an eight-cylinder model of the same bore and stroke developing 1600 to 1800 b. h. p. at the same speed. Furthermore, details are given of the different motor-craft built for the French Navy during the war.

We give on this page an illustration of one of the new Normand designs of cargo motorships. This vessel is of 7200 tons d. w. c. and is a twin-screw vessel with the machinery arranged aft. The speed of this ship is 12 knots on a loaded displacement of 10,500 tons. Two engines of 1350 i. h. p. each provide the power. The shaft power for the ship is 2200 h. p.

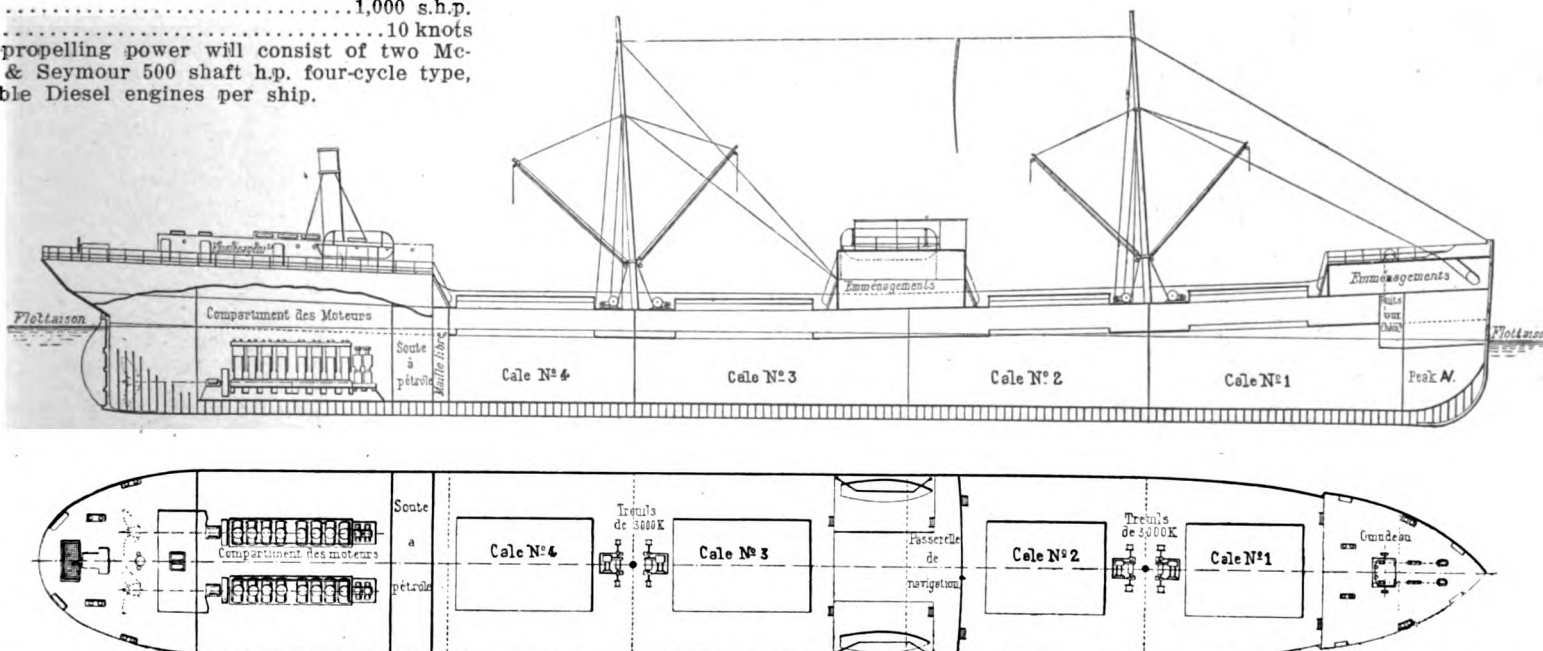


The new American wooden motorship "Donna Lane."

Shipbuilding & Construction Co. of Seattle. Their main dimensions are as follows:

Deadweight-capacity	.....	3,200 tons
Lumber capacity	.....	800,000 feet
Length (O. A.)	.....	260 feet
Length (on W. L.)	.....	247 feet
Fouled breadth	.....	46 feet
Depth	.....	26 feet
Power	.....	1,280 i. h. p.
Fuel-capacity	.....	2,214 bbls.
Cruising Radius	.....	about 60 days
Daily fuel-consumption	.....	about 36 barrels
Power	.....	1,000 s. h. p.
Speed	.....	10 knots

The propelling power will consist of two McIntosh & Seymour 500 shaft h.p. four-cycle type, reversible Diesel engines per ship.



Cargo-carrying motorship of 7,200 tons d.w.c. designed by Augustin Normand of Havre, France, and to have twin 1,350 shaft h.p. Normand four-cycle Diesel engines. Loaded displacement, 10,500 tons.

(Continued from page 301)

The rockers of these lower valves are very short little bell-cranks which can hardly be seen, and it is perhaps this that brings about the absence of any appearance of complication.

A very ingenious attempt has been made to relieve the cylinder-head proper of temperature stresses in that the cylinder top is actually closed in by a flat steel water-jacketed plate on which rests the cover that carries the valves, and through which the valve cages project, so that this plate takes the direct impingement of the combustion temperature; the cover itself is therefore only subject to such heat as may be transmitted to it by conduction, and the only cooling it requires is that which is obtained by the circulation of the incoming scavenge air. Perhaps with a cover complicated by ports for the scavenge-valves a two-cycle engine may require some such device, but ingenious as it is we hardly think it will be subject to imitation to any large extent.

Another point which to our minds is open to question, is the use of fresh-water for cooling some parts, such as the piston and this cover plate, and of salt-water for cooling the main jackets. At least this entails a considerable complication in the pipe arrangement, and we would very much have preferred to see a larger fresh-water cooler installed and fresh-water used throughout. We do not make this criticism for criticism sake, but the maze of little bits of piping about the engine is somewhat of an offense to the engineering eye. There are we should think at least eight little sight discharges for each of the various parts for each cylinder neatly brought together on the top platform so that the flow and temperature can be under observation.

The same sort of criticism applies to the three-

stage air compressor which is driven off the front end of the crank-shaft: the inter-coolers in this appear to consist of a very network of piping, though we must say that the valves are accessible in spite of it.

Six fuel-pumps are fitted to each engine in two batteries of three each, cut out of the solid, three being for the top side and three for the bottom side. Speed control is obtained by varying the lift of the suction-valves in the usual manner, while a centrifugal-governor on one of the vertical shafts checks racing, the movement from the governor being transmitted to the valves by compressed-air and not by links. One feature which was new to us is the fitting of a little fuel-tank right up against the pump from which the pump draws, the level in the tank being controlled by a float designed we presume to give a constant head over the suction-valves and so an even fuel-feed.

The pumps themselves are driven by a very heavy eccentric rod from the upper cam-shaft, the stoutness of this part being typical of the substantial construction throughout the engine, and we can imagine that it must be a great pleasure to see them running. We should be much surprised to find any vibration anywhere. The same remark applies to the scavenge-pump levers which are just like the air-pump levers of a steam-engine, the vertical inverted double-acting scavenge-pumps being bolted to the back-columns and all this should be as firm as a rock.

As auxiliaries, there are two very nice running three-cylinder, four-cycle M.A.N. engines direct-coupled to a generator with a clutch connection to a Reavell air-compressor or charging bottles. There is also a small two-cylinder hot-bulb engine for emergency use in case the supply of air is completely exhausted.

The rest of the auxiliaries, including the turning-gear fuel-distributing pumps, etc., are all electrically driven, as also are the winches and steering gear, while compressed-air is used for the syren. There is, however, an oil-fired Yarrow-type boiler for heating purposes, so we should have liked to see steam used for the syren. Our experience goes to show that in a crowded water-way, and with the wind blowing away from a ship, it is not always easy to tell which ship is whistling, or indeed to hear the whistle at all, and the tell-tale visible steam blasts are a much more reliable method of identification.

In conclusion we should perhaps say a word about the handling of the engines. The three double-acting cylinders give of course the same starting effort as six single-acting two-cycle cylinders, so that if the double-acting principle is not in fact open to the objections we have postulated above, and if a double-acting cylinder can be made to give double the power of a single-acting cylinder of the same diameter, we could then halve the number of cylinders which are at present required to be installed, solely to meet the needs of maneuvering, and a great simplification instead of a complication would result.

Though, as we have said above, nothing has as yet been definitely proved by the present set, it is upon this note of hopefulness in the possibilities of simplification in the future that we should like to conclude, in the firm belief that, in view of the fact that less than ten years have elapsed since the first ocean-going Diesel engine ship ran her trials, it is impossible that anything approaching the final development of this form of motive power can yet have been reached.

BASIL H. JOY.

SMALL DUTCH MOTORSHIPS BUILT DURING 1919

Twenty-five Craft with Surface-Ignition Oil-Engines

It is of interest to record that during 1919 no fewer than 25 small oil-engined coastwise motor-craft were completed in Holland. They aggregated 8493 tons and 2582 b.h.p.

Name of Boat	Tonnage	Horse-power	Owners	Builders	Engine
Weesperkspeel	625	180	V. Holl Rekenning.	G. & H. Bodewes Bros. of Martenshoek.	Steynaard & J. Walen, Rotterdam.
Ubbekarspel	625	140	V. Holl Rekenning.	G. & H. Bodewes Bros. of Martenshoek.	Kromhout Motorenfabriek, Amsterdam.
Kwiek	450	90	V. Holl Rekenning.	G. & H. Bodewes Bros. of Martenshoek.	Steynaard & J. Walen, Rotterdam.
Rap	450	90	V. Holl Rekenning.	G. & H. Bodewes Bros. of Martenshoek.	Steynaard & J. Walen, Rotterdam.
Emily	400	120	Holl. Vrachtvaart Mij., of Rotterdam.	D. Boot Gouwsluis en Alphen, a. d. Rijn.	Joh. Boot.
No. 654	180	120	Erven P. den Dulk, of Scheveningen.	D. Boot Gouwsluis en Alphen, a. d. Rijn.	Joh. Boot.
Vrijenban I	225	90	N. V. Vrijenban I.	H. Root & Zonen, of Vrijenban.	Drakenburgh Co., Utrecht.
Vrijenban II	190	40	N. V. Vrijenban II.	H. Root & Zonen, of Vrijenban.	Kromhout Motorenfabriek, Amsterdam.
Misoa	350	90	Caracasche Petroleum Comp. of Caraca.	Goor & Spiekman, of Zwartsluis.	Kromhout Motorenfabriek, Amsterdam.
Padla	400	90	Armen A. Depper of Rotterdam.	H. Z. N. J. Koster, Gideon Werf, of Groningen.	Kromhout Motorenfabriek, Amsterdam.
Leksveer	500	300	M. J. van der Eb, of Rotterdam.	Scandinavie Werf, of Groningen.	Drakenburgh Co., Utrecht.
Pax	200	45	V. Deensche Mek.	W. F. Stoel & Zn. of Akmar.	Kromhout Motorenfabriek, Amsterdam.
Cary	600	130	Scheepvaart Mij. of Poseldon.	Gebr. Tak, of Geertruidenberg.	N. V. Maschinenfabriek, Bolnes.
Sophia	249	120	Vrachtv. Mij. Neerlandia, of Rotterdam.	J. Vos & Zn. of Groningen.	Drakenburgh Co., Utrecht.
Haabet	600	130	Svend Nielsen Naleskov, of Danem.	J. Th. Wilmink & Co., of Groningen.	Steynaard & J. Walen, Rotterdam.
Marie	50	180	Ned. Indie Govt.	J. Meyer Schrepp Mij., of Groningen.	Steynaard & J. Walen, Rotterdam.
Sleka 4	200	45	W. Mulder, of Stadskanaal.	W. Mulder, of Stadskanaal.	Kromhout Motorenfabriek, Amsterdam.
Bosco	575	130	Vrachtv. Mij. Neerlandia, of Rotterdam.	W. Mulder, of Stadskanaal.	Kromhout Motorenfabriek, Amsterdam.
Clara	600	130	Vrachtv. Mij. Neerlandia, of Rotterdam.	Gebr. Muller, of Foxhd.	Kromhout Motorenfabriek, Amsterdam.
Kramner	500	130	N. Haas & Co.	Gebr. Muller, of Foxhd.	Kromhout Motorenfabriek, Amsterdam.
Uniac, Acoreana	420	130	Portugese Owners.	J. Pattje & Zonen, of Waterhuizen bij Gr.	Kromhout Motorenfabriek, Amsterdam.
Nieuwe Zorg	50	26	A. V. D. Gruyter, of Arnhemuiden.	P. & A. Ruijtenberg, of Waspijk.	Maschinenfabriek, Bolnes.
Unnamed	50	26	Gebr. Gleling, of Helder.	Voorvuit Werf of Erikhuizer.	Kromhout Motorenfabriek, Amsterdam.
Total	8,493	2,582			

The Motorship and the Senate

Opinions of Notable Men Regarding Diesel-Engined Merchant Vessels

Further opinions regarding Diesel-engines and motorships were given during the recent hearings before the U. S. Senate Committee on Commerce. In our last issue we gave the statement of Mr. Frank Munson, of the Munson Steamship Line, of New York, and we now append the view of another notable man.

Statement of Admiral R. E. Coontz
(Chief of Naval Operations, U. S. Navy)

Admiral Coontz. The fourth and last of the points on which I desire to touch is that of research and experimental. The Navy should, through its laboratories and experimental stations, assist the merchant-marine designing and constructing engineers in every way possible to increase the efficiency of these vessels, especially with a view to the development of oil-burning and Diesel engines.

My reason for this statement is that economy and simplicity of operation are vital to the success of the merchant vessel. What assistance, advice, and aid the Navy can give toward the accomplishment in engineering construction and reduction in cost of opera-

tion, should be given unhesitatingly and freely. It will assist in bringing the two services in closer relations.

The Chairman. What do you know about the Diesel engine? I receive a great many communications, some very urgent ones, pointing out what appears to be a very great chance in the Diesel engine and its development. What do you know about it?

Admiral Coontz. I am not an engineer, Mr. Chairman, and of my own knowledge I know but little about it. However, all the information and everything that comes our way leads us to believe that it is a mighty good proposition and that it is going to be economical and efficient, but my knowledge is purely that and nothing more.

The Chairman. Do you hear that in regard to the Diesel-engined motorship or the Diesel motorship?

Admiral Coontz. I do, but I will also state that I read a great deal of that in publications that might be more or less prejudiced, such as "MOTORSHIP" and all shipping and

yachting magazines, but I have no reason to doubt it. All the evidence is one way.

The Chairman. It seems to me the Navy ought to experiment along those lines.

Admiral Coontz. So far as I know the Navy does experiment along those, as all other lines.

DUTCH ENGINES INSTALLED IN GERMAN SHIP

Two Kromhout surface-ignition oil-engines have been installed in the German ship "Willkommen" of 203 tons gross. The vessel is owned by H. Propfe & Company of Hamburg.

SWEDISH MOTORSHIP RUNS TRIALS

Trials have just been run of a motorship of 4,450 tons d.w.c. This vessel has been built at Landskrona for the Rederi A/B Severige of Levante, Sweden.

AMERICAN ENGINES IN ITALIAN SHIPS

The wooden twin-screw auxiliary-schooner "Snia Austin" of 2,237 tons gross is now in the service of the Societa di Nav. Italo Americana of Genoa. In this vessel twin 200 b.h.p. cylinder Fairbanks-Morse surface-ignition type heavy oil engines are installed. She was built by the International Shipbuilding Co. of Orange, Texas.

Interesting News and Notes from Everywhere

TANKER FOR TEXAS COMPANY

Two 500 h.p. McIntosh & Seymour-Diesel engines are being installed in a 325-ft. tanker now building by the Texas S. S. Co. at Bath, Me. A speed of 8 knots is expected.

BRITISH GOVERNMENT ORDERS DIESEL-ENGINES FOR MERCHANT-SHIPS

It is said that the British Government has placed orders for Diesel-engines for propelling installations for the merchant-ships to be laid down at Chatham Dockyard.

THE MOTORSHIP "BUENOS AIRES"

In an early issue of "Motorship" we hope to publish an illustrated article on the Swedish motorship "Buenos Aires," which was launched when our Editor was in Göteborg. She has passenger accommodation of the most luxurious character.

BETHLEHEM CO.'S MOTORSHIP

In our last issue we stated that the name of the motorship building for the Ore S. S. Company at the Bethlehem Shipbuilding Company was "Hagood." This, however, is an error, the name of the motorship in question being "Cubore."

THE MOTOR LINERS FOR THE BRITISH INDIA STEAM NAVIGATION CO.

(Additional Notes)

With reference to the four Diesel-driven passenger liners for the British India Steam Navigation Co. and Union Steamship Co. of New Zealand, first and exclusively announced in "Motorship" of November, 1919 (Pages 52-53), we understand that Barclay, Curle & Co. of Glasgow will build two of the hulls and that Messrs. Robert Duncan & Co. will build the third. The name of the builder of the fourth ship has not been announced. Two of the ships will have a speed of 13½ knots and the others will be of 12½ knots, and the Diesel-engines are building at the North British Diesel Engine Works, Glasgow. The ships have the following dimensions:

Dead-weight-capacity	10,670 tons
Length	450 ft. 0 in.
Breadth	58 ft. 0 in.
Depth	35 ft. 6 in.
Draught	27 ft. 11 in.
Power of main engines	4660 I.H.P.
Engine speed	96 R.P.M.
Power of auxiliary engines	1400 h.p.
Type of auxiliaries	Diesel-Electric
Ship's speed	13½ and 12½ knots

In an early issue we hope to publish plans and photographs of these interesting motorships.

BETHLEHEM STEEL COMPANY TO BUILD CAMMELL-LAIRD FULLAGAR ENGINES

Report has reached us that the Bethlehem Steel Company is taking out a constructional-license for the Cammell-Laird Fullagar opposed-piston type marine Diesel engine. Details of this engine are given on other pages of this issue.

LAUNCHING OF THE MOTORSHIPS "ATHENE" AND "SAN MIGUEL"

The 6,600 tons d.w.c. motorship "Athene" was launched at the Rijkse shipyard "Rotterdam" on Feb. 4 last, and the 3,000 ton steel motorship "San Miguel" was launched from Smit's yard, Kinderdijk, Holland, at the end of January. The latter is a single-screw ship. Both vessels have Werkspoor Diesel-engines installed.

DAY SUMMERS TO BUILD KROMHOUT ENGINES

Perman & Co., Ltd., of 82 Fenchurch street, London, England, who represent the Kromhout surface-ignition marine oil-engine in that country, have made arrangements whereby this engine in the future will be built by Day, Summers & Co., Ltd., of Northam Ironworks, Southampton. Messrs. Day, Summers & Co. are well-known builders of coastwise craft up to 700 tons d.w.c. and are able to undertake the conversion of existing vessels, as their yard is equipped with two ships capable of hauling vessels of 500 and 1,000 tons, respectively. Furthermore, they have a very complete and self-contained plant with brass and iron foundries and a good-sized forging shop.

NORWEGIAN GOVERNMENT AND MOTORSHIPS

Although the Norwegian State Council has decided to return 70 steamships to their owners, it has decided that the official directorate shall continue to control the operation of their three motorships, "Folkvard," "Landvard" and "Lidvard"; also other Norwegian motorships.

WAR DEPARTMENT SPARK PLUG SPECIFICATIONS

We have been requested to announce that the office of the Motor Transport Corps, War Department, Washington, D. C., has just issued new spark-plug specifications.

These specifications have been adopted as standard by the Motor Transport Corps, U. S. Army, and any commercial spark-plug, in order to



Concrete vessel built for the British Admiralty

be purchased for the use of the Motor Transport Corps, must first have been tested under these specifications, found satisfactory, and placed on the approved list for purchase. Any commercial concerns desiring War Department business on spark-plugs for truck or passenger car engines should submit at once samples of their plugs for test, as specified in paragraph 1 (f) of the specifications. Samples should be sent to the engineering branch, Motor Transport Corps, 7th and B Streets, N. W., Washington, D. C.

Unfortunately, pressure on space prevents us from publishing specifications, but copy can be ob-

OUR EFFORTS NOT IN VAIN

Senator Jones' New Bill

We are glad to say that our efforts to induce Congress to authorize the U. S. Shipping Board to balance our existing fleet with new economical motorships and then turn them over to private interests apparently will not have been in vain, because the new bill introduced by Senator Wesley L. Jones (the strong-man of Congress) includes:

(1) The creation of a fund, derived from the sale of ships, to be made available by the board in aiding new construction of desirable ships.

(2) A fund is created which the Board can use to construct or aid in constructing up-to-date, most highly equipped and most suitable and economical ships needed in our contest for the world's trade.

(3) Such a marine is to be owned and operated ultimately by private parties and capital.

* * *

tained from Capt. G. R. Young, Motor Transport Corps, War Department, Washington, D. C.

DIESEL ENGINE CASTINGS

On the 30th of January a very interesting paper on Diesel engines and castings was read before the North East Coast Institution of Engineers and Shipbuilders, Wallsend-on-Tyne, England, by Mr. F. J. Cook. If we can find space in an early issue of "Motorship," we will publish the leading features of this paper.

NEW CAMMELL-LAIRD-FULLAGAR ENGINE MOTORSHIP OF 5,500 TONS FOR ANCHOR-BROCKLEBANK LINE

We recently referred to several motorships being on order for Liverpool shipowners, which craft are to have Cammell-Laird Fullagar Diesel-engines. One of these vessels is for the Anchor Brocklebank Steamship Line and will be of 5,500 tons d.w.c. She has been named "Mafia" and has the following dimensions:

Dead-weight-capacity	5,500 tons
Length	350 ft. 0 in.
Breadth	49 ft. 9 in.
Depth	37 ft. 0 in.
Draught	23 ft. 0 in.
Power	2000 shaft H.P.
Speed	11½ knots

The machinery will consist of two four-cylinder, two-cycle, opposed-piston-type engines of 1,000 shaft H.P. each at 110 revs. per minute. The cylinders will have a bore of 18½ ins., and the two pistons per cylinder will have a combined stroke of 50 ins.

Messrs. T. & J. Brocklebank, Ltd., of Liverpool also own the 500 tons welded-steel coastwise motorship "Fullagar" recently launched at the same shipyard.

FRAMING OF DIESEL-TYPE ENGINES

Owing to the great pressure on space, even in this enlarged issue, we regret we have been obliged to hold over the second part of the article on "The Framing of Diesel-type Engines" until our May issue.

OUR READERS' OPINIONS

We regret the unusual pressure on our editorial space has again forced us to hold-over the "Readers' Opinions" page until our next issue.

SULZER ENGINES IN ITALIAN SAILING SHIP

The 264 tons gross three-masted schooner "Zapor," built in 1910 by the M. U. Martinolich of Lussinpiccolo, has been fitted with a four-cylinder 420 h.p. Sulzer two-cycle Diesel-engine. The vessel is owned by the Soc. Annon di Nav. Maritt Atlantica di Fiume.

SMALL DUTCH MOTORSHIP

Mr. G. Huizink of the N. V. Commerciale, My. tot Exploitatie van Vaartingen, of Amsterdam, Holland, has named their new steel 408 tons gross motorship—the "Obbekarspel." The craft is powered with a Kromhout oil-engine and was built by Gebr. G. & H. Bodewes of Martenshoek. The sister motorship has been named "Weesperkarspel," and is propelled by a Standaard heavy-oil engine.

MOTOR DRIVEN TRAIN FERRY

An interesting little train ferry has been built of steel by the A/S Rodby Havns Skibsværft of Rodby, Denmark, for service between Gaalse and Masuedsund. The vessel is 80 ft. long by 70 ft. breadth and is propelled by a two-cylinder Tuxham surface-ignition oil-engine of 100 b.h.p.

AUXILIARY RUNS TRIALS

Trials have been run of the 625 tons d.w. wooden auxiliary motorship "Ulva," built by Brastad S. B., Molde, for Molde Rederi A. S. Length 140 ft. by 28 ft. breadth and 15 ft. depth. A 160 h.p. Bolinder engine has been installed.

The Sal Hydro-Electric Log

An Ingenious Mechanism for Giving the Ship's Speed and Distance Run

When we described the 9,400 tons d.w.c. motorship "Bullaren" in our January, 1919, issue, we referred to an excellent piece of mechanism that we believed it would pay every shipowner to install on board all of his ships, whether steam or motor, it having been shown by sets in service the navigation time saved by use of this log during a single voyage has paid the entire cost of installation. This was the Sal hydro-electric log which we illustrate on this page. When we were in Stockholm, Sweden, we made a special point of visiting the plant where these logs are made and were impressed by the quality of workmanship, both design and construction.

The makers are the Svenska Aktiebolaget Jungner, represented in the U. S. A. by Hamilton & Hansell, Inc., Park Row Building, New York. The Sal-Log, or Sal Hydro-Electric Log, as it is called, is based upon the pivot principle, i. e., the pressure created during the speed is taken up through a tube protruding about 10 in. from the bottom of the ship. This pressure is made to act upon the mechanism of the log apparatus on which both the speed and the distance can be read in the engine-room, and the distance can, however, be read off anywhere in the ship and the reading instruments are electrically operated from the log apparatus. Usually a duplicate indicator is fitted on the navigating-bridge. The necessary current is taken from a NIFE storage-battery, the capacity of which will be sufficient during a distance of 15,000 miles without recharging. The protruding Pitot-tube ($\frac{3}{4}$ in. diameter) is mounted in a sea-cock and can thus easily be drawn in or pushed out whenever it will be necessary.

After the first 28,000 miles on the "Stavangerfjord" it was found that the instrument was

most satisfactory, as will be seen by the curves below, which give the summer trips from July to September. These curves represent the difference caused by the current between the observed distance and that given by the Sal-Log on board this ship.

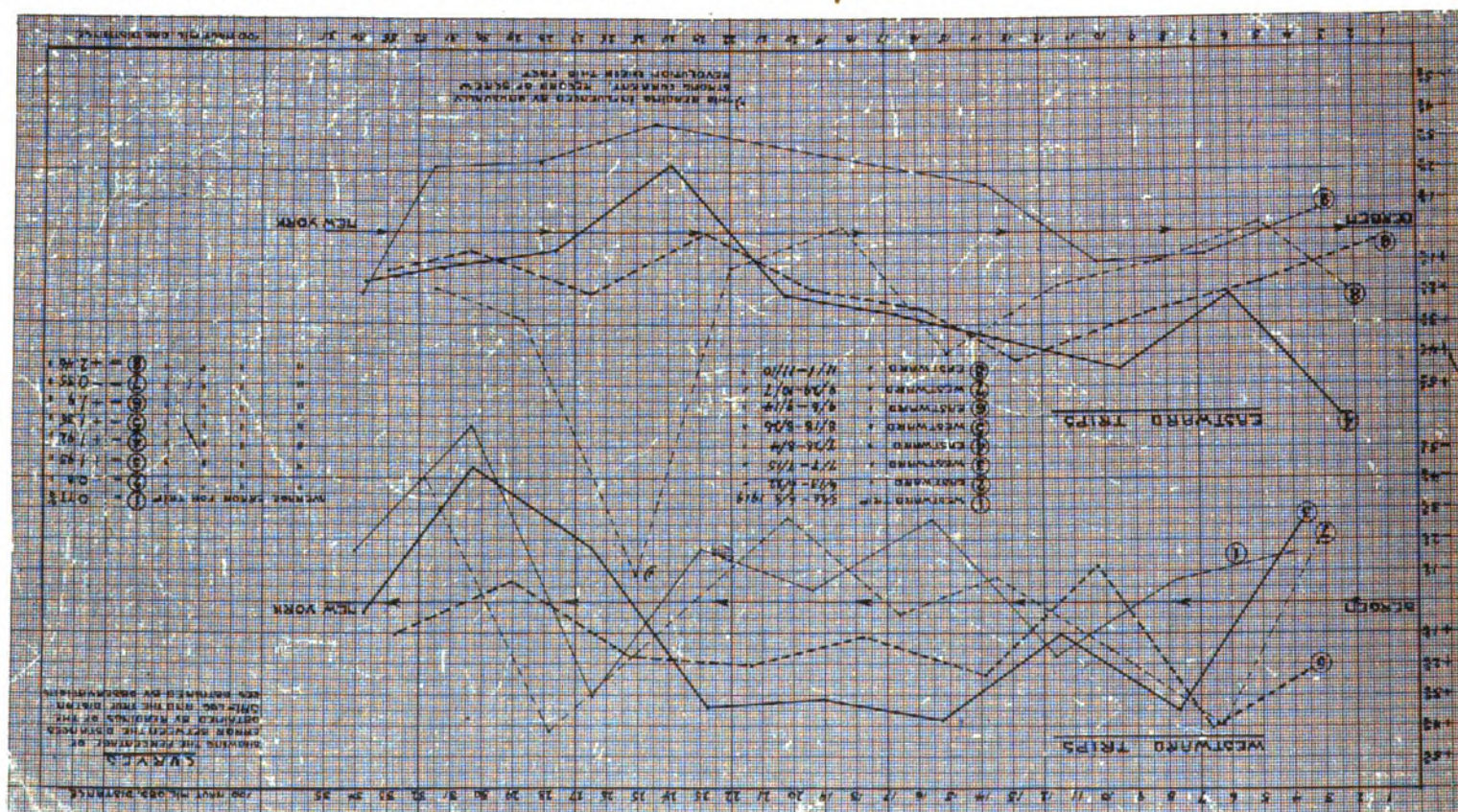
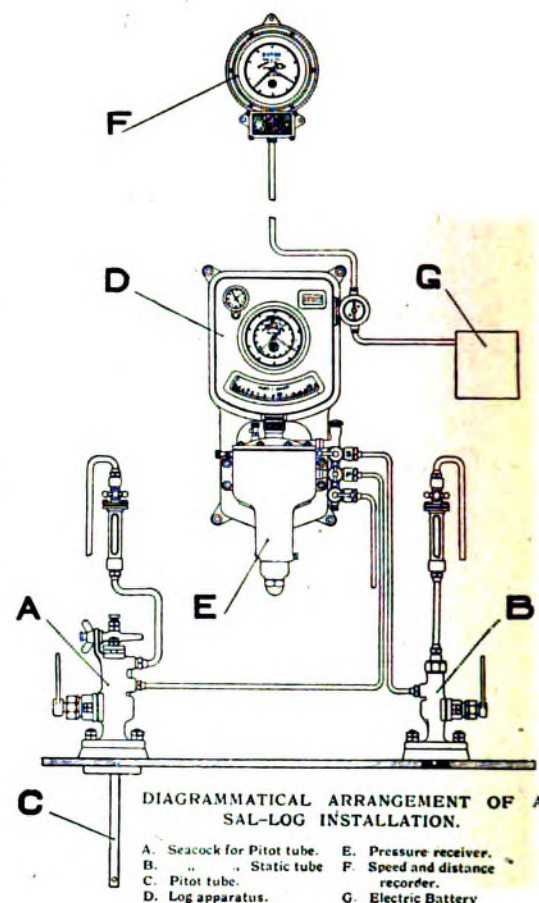
On the horizontal line are plotted the observed distances each day, and at these points vertically the percentual plus or minus difference. The full analogy between these curves are evidently proofs of the astonishing accuracy and reliability of the mechanism.

The daily differences between the observed and the log distance during the trips nr. 2 and 4 could thus have been figured from the curves obtained during the trips nr. 1 and 3 with great accuracy. This must be considered to be of extraordinary value for a safe navigation, particularly for ships running over a certain route, on board of which tables could be made up showing the strength of the current at the different places. From these an average value could be figured and used for correcting the log readings.

We understood that the two 11,200 tons motorships for the American Hawaiian Steamship Co. will probably have these logs installed, as will the motorship "Stureholm" when she returns to Sweden. At an early date we expect to publish a complete technical description.

RECENT VOYAGES OF AUXILIARY MOTORSHIPS

Recently the 320 h.p. Bolinder engine in the Standard Oil Company's schooner "Starlite" ran 54 days without a single stop, covering 6,900 miles at an average speed of 5 knots, the engines averaging 202 R.P.M. The fuel-consumption was 71



Curves showing difference caused by current between the observed distance and that given by the Sal hydro-electric log.

THREE MORE MOTORSHIPS ORDERED FOR THE SWEDISH-AMERICAN MEXICAN LINE

We have been advised that the Swedish-American Mexican Line of Gothenburg has ordered three additional motorships each of 9,400 tons d.w.c. of 4,000 I.H.P., and of 13 knots speed, from the Gotaverken of Gothenburg. These vessels are very similar to the motorship "Stureholm," and the order has been placed this year. The motorship "Stureholm" is at Pier 90, Foot of 50th Street, North River, loading cargo.

OIL IN PAPUA

British oil-interests are going to develop the Papua oil-fields where the Commonwealth of Australia has already expended half-a-million dollars. The British Government has agreed to contribute \$125,000.00 towards the development of these oil-fields.

gallons per watch and the lubricating-oil consumption 3½ gallons. This is in accordance with the statement by P. Nelson, Chief-Engineer of the "Starlite."

Recently the "Sierra" arrived at San Francisco, having made the trip from Iquique in 28 days with 1,354 tons of nitrates.

The Pacific Coast-built auxiliary "City of Portland," now owned by French interests, lately crossed the Atlantic from Marseilles, France, to Beaumont, Tex., in 28 days. Furthermore, the sister-ship "City of St. Helens" made a voyage from Ceylon via Suez to Marseilles in 50 days, of which 15 days were lost through a delay through the canal.

According to J. F. Atkinson, Chief-Engineer of the "Santa Flavia," owned by W. R. Grace & Co., this ship has made the following trips during the past twelve months:—

Left Port Arthur, Tex., Dec. 5, 1918, to South Norwalk, Conn., and from New York to the west coast of South America to Sal-lavery, Peru. Sallavery to New Orleans, via Colon and Pt. Barries, Guatemala. New Orleans to Barbados, B. W. I., via Cienfuegos, Cuba, Guadeloupe and Martinique, F. W. I. Barbados to New Orleans via La Guira, Venezuela, Pt. Cabelle and Colon. New Orleans to Bilbao, Spain; Bilbao back to New York. New York to New Orleans. New Orleans to Bilbao; Bilbao to Vigo, Spain; Vigo to New York, arriving New York Dec. 1, 1919.

During these twelve months 9 cargoes were handled. Ship logging approximately 32,000 miles. Mt. Atkinson states that there was only one hot bearing during this time. The engines average from 200 to 210 r.p.m., and the oil consumed per day averaged 22 barrels (42 gallons per bbl.).